

August 2010

Nutritious Water Chestnut

Pg 53

Land Mines!

Pg 32



Science Reporter



A CSIR Publication

The Modern Day Tragedy

Water

Plus

- *Intriguing Epigenetics*
- *Aha! Moments*
- *Cancer in Children*
- *Water Management*
- *Fiction and Humour*





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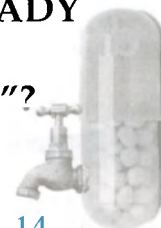


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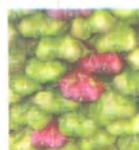
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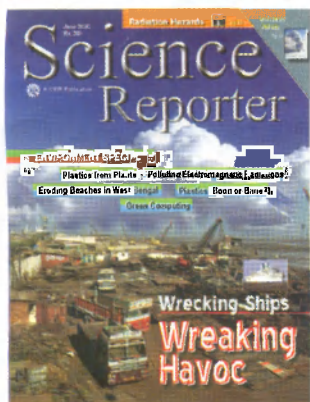


THE FORSAKEN WATER CHESTNUT!

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Preserve for Future Generations

The May 2010 Biodiversity Special issue of *Science Reporter* is worth preserving as it focuses on a subject so important for human survival. Every aspect of our life is sustained by the Earth's biodiversity. While plants and animals keep you well fed and healthy, through photosynthesis trees absorb and store atmospheric carbon, helping to combat global warming and purifying the air we breathe. Forests also control soil erosion and purify water.



There are several factors responsible for the degradation of biodiversity, the primary among them being the destruction of habitat and habitat fragmentation leading to the movement of species to other habitat where they find it difficult to adapt. Another reason is the extensive hunting of wild animals and the over exploitation of plants and trees in the wild. Biodiversity has been under threat since the last century due to the bulldozing development initiatives of mankind.

Biological resources must be conserved if they are to continue supporting life on Earth. The Copenhagen (COP-

10) slogan, "Life in harmony to the future" articulates the need for coexistence between humans and biodiversity for the sake of future generations. Let us make concerted efforts for the conservation of biodiversity.

Dr. S.K. Aggarwal
Dean Academics
Amritsar College of Engineering and Technology

Avalanche Hazard Rating

In connection with the article A for Avalanche by Dr. Sukanya Datta (May 2010) I would like to add that the danger posed by an avalanche is designated low, moderate, considerable, high or extreme, the corresponding



colour representations for which are green, yellow, orange, red or red with black border. Travel in an avalanche-prone area in the first case can be considered somewhat safe but for the last one it is fraught with dangerous consequences.

The danger from avalanche is determined by the amount of material it contains. Avalanche size may vary from 1 to 5. A class 1 avalanche can knock down a person but not bury him, whereas a class 5 avalanche can destroy a town. Like earthquakes, each avalanche class is 10 times more powerful than the previous one. Thus a class 2 is 10 times more powerful than a class 1, whereas a class 3 is 100 times more powerful than a class 1.

Dr. S.K. Gurtu
Jaipur

Informative Topics

Kudos to *Science Reporter* for the excellent write-ups Adding Fizz to Science! and Secrets of Plant Pigments in the February issue.

While the writers Jayanarayan Panda & Bikash Ranjan Mohanty have hemmed in the precious information on the changing role of science museums and science centers in disseminating knowledge of science in an easy-to-understand style in an attempt to build up scientific literacy, Dipanjan Ghosh's endeavour to enlighten primarily the students and common masses on a scintillating topic such as the secrets of colours in plants and fruits will certainly go a long way in playing the role of a guide in a much significant and commendable way.

Asheko Datta
Tezpur (Assam)

Reaching Remote Areas

I want to commend you on bringing out such a reputed science magazine. I live in a highly remote area of J&K where getting education is quite tough and a big challenge. I am pursuing B.Sc. with biotechnology currently. I am a regular reader of *Science Reporter* and have hardly

missed any issue of this magazine since 2008. The general layout, language and illustrations of this magazine are truly matchless. However, I would like to suggest that you add a special section to SR entitled 'Inventions & Discoveries'. This section should provide information about the way a number of scientists came up with their eventual idea, invention or discovery.

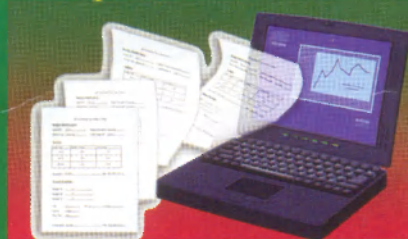
Mohd Arif Khanday
Anantnag (J&K)

Key to Success

I have been reading *Science Reporter* for the past eight months. I had never thought that the information that I was getting from the magazine would help me in competitive exams. But, now I can say that the scientific information that the magazine provides is very helpful in any kind of competitive exam. I can say that the magazine has been a key to my success.

Satyam Anand
Bihar

Science Reporter is Now Online!



Issues of *Science Reporter* are now available online. However, for the moment, this facility is open **only for subscribers** of the print edition. To access issues of the magazine online, subscribers need to register at <http://nopr.niscair.res.in> with their E-mail address. Subscribers also need to communicate their subscription numbers and E-mail addresses with which they have registered to sanjayburde@niscair.res.in. After registration, an activation link will be sent to you through which you will be able to access issues of *Science Reporter*.

In case of any problems during registration, please write to:
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Nurturing Water Reservoirs for a Better Future

Isn't it ironic that we contaminate, choke and waste our precious water resources and then lament, quarrel and even kill for water? In recent times, the battle over drinking water has gotten worse.

In March this year, cops had to be deployed in the Ranikhet Cantonment Area at natural springs around the town so that water could be made available to all residents. The area is reeling under a water crisis due to drying up of local springs. In the same month, in Indore, a teenage girl was stabbed to death when she tried to draw water from her neighbour's tap in a city plagued with water scarcity. In fact, the MP government has roped in police forces to oversee distribution of water from tankers in many of its cities. Meanwhile, in June a 22-year-old man was shot dead and two others injured in a fight between two groups over water in Delhi. The scenario could only worsen further.



While wastage and contamination of water could perhaps be addressed by conscientious individuals to some extent, the bigger issue is the total neglect of local water bodies that are being left to dry up. The most recent instance is of a once sprawling water body in Haryana being offered to private developers for construction. The Haryana Urban Development Authority (HUDA) is developing a lake in Ghata village on the foothills of the Aravalis in Gurgaon as Sector 58 and builders have already started work on

a portion of the lake-bed. The lake once used to be a favourite attraction for young swimmers. The last time the lake was completely filled with rainwater was in 2003. And then, it was only last year that news came of the Badkhal Lake, a popular picnic spot near Faridabad known for its migratory birds, drying up completely. It's the same story with Surajkund and Damdama Lake—two other picturesque picnic spots around the national capital. Reckless mining and choking up of the natural rain water supply due to massive colonization around the lakes has completely shriveled up the water bodies.

It is pretty much the same story all over India. Bhopal, known as the city of lakes, is facing severe water crises because several of its lakes are dying. Bangalore, which in the 1960s boasted of 260 water bodies, is now left with only 100 of them. And even these 100 are either shrinking or are threatened with encroachments and weed growth. Meanwhile, according to latest reports, tourism has been severely affected in India's northwest city of Udaipur as its five famous lakes are drying up. The Sukhna lake, often called the soul of Chandigarh, is also gasping for breath, or rather, water.



Local water bodies perform a very important function—recharging the underground aquifers—and thus serve as drinking water lifelines for surrounding areas. They capture a substantial part of the rain water, which otherwise would have flown into drains and rivers, and help a major part percolate through to the underground reserves of water. The instances of plummeting water tables being reported from around the country are the direct result of over-exploitation of underground water reserves, with little replenishment.

While citizens at various places seem to have realized the importance of nurturing the water bodies in their vicinity, the awareness needs to spread throughout the country and to various levels. While the government needs to put into place mechanisms to sustain water reservoirs, it is equally incumbent upon local communities, and even school and college students, to realize the significance of water bodies in their surrounding areas and take it upon themselves to see that these precious water resources are neither contaminated nor choked to death.

Hasan Jawaid Khan

Printed and published by Deeksha Bist on behalf of the National Institute of Science Communication And Information Resources (NISCAIR), CSIR, Dr K S Krishnan Marg, New Delhi-110 012 and printed at Brijbasi Art Press Ltd., A-81, Sector-5, Noida-201 203.

Science Reporter is published monthly by the National Institute of Science Communication And Information Resources (NISCAIR), CSIR, Dr K S Krishnan Marg, New Delhi-110 012. NISCAIR assumes no responsibility for statements and opinions advanced by the authors or for any claims made in the advertisements published in Science Reporter.

Phones: Editorial: 91-011-25848702 Sales/Subscription: 91-011-25841647 Advertisement: 91-011-25843359 Fax: 91-011-25847062

Email: Editorial: sr@niscair.res.in; hjk@niscair.res.in Sales: lkc@niscair.res.in Website: <http://www.niscair.res.in>

Subscription: Inland: 1 yr: Rs 200/-; 2 yrs: Rs 380/-; 3 yrs: Rs 540/- Foreign: 1 yr (Air Mail): US \$ 65

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WATER is the greatest gift of nature. But, unfortunately, a gift that humans are squandering away. The world is fast heading towards a water crisis. Its shortage is likely to be so acute that the next world war may be fought on sharing of water resources among various countries. The tensions are all too visible even now. And at the local level even lives have been lost owing to quarrels on water sharing.

According to UN estimates, the total amount of water on earth is about 1400 million cubic kilometer (m.cu.km.), which is enough to cover the earth with a layer of 3000 meters depth. The potable water constitutes 2.7% of the total water of which about 75.2% lies frozen in polar regions, 22.6% as ground water and 2.2% is available in lakes, rivers, atmosphere, moisture, soil and vegetation.

The situation in India is disturbing because we have only 2.45% of the world's landmass to support 16% of the world's population. The available water is shared between agriculture

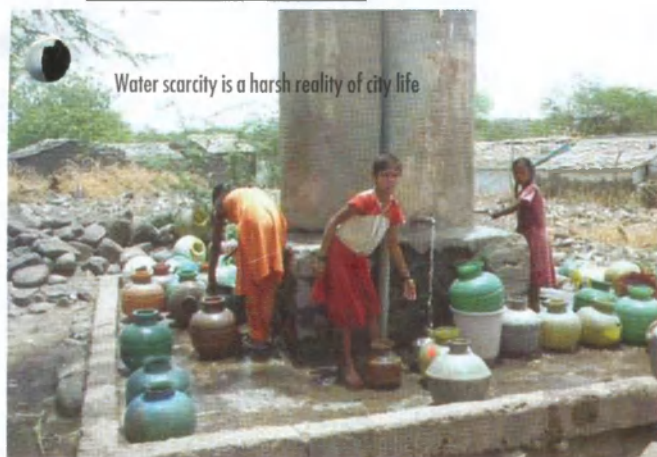
There Goes 'The Elixir Of Life' ... Water!

Extreme water scarcity in the country's metro cities could be a reality sooner than expected. Delhi is a prime example. Communities, individuals, and industries will have to join hands with government agencies to ward off this not so distant possibility.



K.P. AGRAWAL

Taps will soon run dry if appropriate steps are not taken



The priceless resource of water can be considered limitless only if used in a sustainable manner.



(74%), hydropower (18%) and households (8%). The water effectively available for domestic purposes is an amount that borders on a state of scarcity according to international standards. With population growth and change in lifestyle, the annual demand is expected to increase at least two-fold by 2030 (demand 1,500 cubic km against projected availability of 744 cubic km).

The water demand in Delhi is about 1,000 MGD while the supply is 670 MGD. Delhi gets raw water from Yamuna, Ganga, Bhakra Beas Management Board and ground water. The ground water, which is the primary source of water for drinking and irrigation purposes, is depleting fast and is unable to meet the demand. The quality is also deteriorating (with high levels of chlorides, sulfides and nitrates) and is not safe for use.

According to a Confederation of Indian Industries (CII) report, Delhi's water table is falling almost 10 feet per annum and has dropped to 350 feet in most places as compared to 30-40 feet at the time of independence. With a projected population of 25 million in 2025, Delhi would need an additional 1,200 MGD of water, which is difficult to meet with existing resources.

The water scarcity in newly coming up colonies is acute. The case of Dwarka, the biggest colony in Delhi is cited. MCD supply is less than an hour a day that fulfills 20-25% of the

demand. Residents are mostly dependent on underground water, which is also scarce, and of sub-standard quality. With acute shortage of water, the residents have to depend on DJB or private water tankers that charge about Rs. 1000 for a tanker load which is not affordable by everyone, neither sustainable in the long run.

Why the Crisis?

The present water crisis in the capital of the country has several reasons to blame. Some of these are.

- Growing population, increasing industrialization and urbanization coupled with poor management of water resources. In spite of several schemes on rainwater harvesting, two-third of the rainwater flows out to the sea. Out of the total annual precipitation of about 4000 billion cubic meters (BCM), the annual availability of water is about 1120 BCM in the country.

- Construction of *pucca* roads, flats, industrial establishments and government offices has left very little open *kachcha* space through which surface water can percolate into the ground. In Delhi alone, such concrete expansion covering about 370 square km of agricultural area has deprived of 89 MGD groundwater recharge through seepage if the city gets normal rainfall of 40 cm in the monsoon. Further, construction work in the ridge area and in the Yamuna basin has

adversely affected and would continue to affect groundwater recharge.

- Of the total water produced in Delhi (730 MGD), 345 MGD (about 50%) is leaked through different sources like water treatment plants, pipelines and theft directly from the pipelines. Thirty per cent of the rainwater along with industrial and household effluents goes waste into gutters, 60% of the rainwater is drained into rivers and hardly 10% rainwater is harvested for domestic and other uses.

- Over three lakh illegal booster pumps pull out water before it reaches the residents located at the end of the network.

- Unequal distribution, for instance, 29 liters per capita per day of water supply in some areas compared to 500 liters per capita per day in VIP areas (much above the national standard of 130 liters per person per day) is also a factor.

- Contamination of waterways and underground water by untreated sewage and wastewater discharge. About 700 water bodies (ponds, lakes, *baolis* etc) in Delhi, because of their heavily silting, are being used as garbage dumps and their encroachment has resulted in drastic reduction in storage capacity and ultimately poor recharge of groundwater. Opening of sewage drains in several water bodies has polluted both surface and groundwater. Delhi contributes 80% to

Leaking water pipelines should be immediately reported

Overflowing sewers pollute drinking water sources

Practise Before You Preach

There is a lot that we can do at the individual level to save water and use it more efficiently. Here are a few tips that could be observed by each household:

In the Bathroom:

- Do not leave the tap running while brushing the teeth, shaving and washing clothes.
- Use showers judiciously. Install water-saving showerheads (bathing accounts for 32% of residential water use).
- Fill your bathtub only halfway and close it before turning on the water.
- Check water taps, pipelines and toilet tank for leaks. Seal if necessary.
- Internal service pipelines if rusted and corroded should be immediately changed.
- Putting a container filled with water in toilet tank (cistern) can save 1-2 liters of water in each flush or install low flush toilets or switch over to ventilated improved pit latrines (these are odourless and do not use water).
- Use ashtray or wastebasket in the toilet to keep it clean.
- Ensure that all the taps are closed when not in use.
- Intermittent water supply schedule reduces wastage of water.
- Do not use drinking water to clean car and for mopping floor.
- Use of water efficient appliances can save as much as 35% water.



In the Garden/Park:

- Trees and shrubs with deep root systems should be watered less frequently than shallow rooted plants that require smaller amounts of water more often.
- Most lawns, shrubs, vegetables and flowers need just one inch of water a week. Do not flood them. Water during cool parts of the day to cut down evaporation.
- Use sprinkler and drip irrigation system for watering gardens and lawns.
- Plantation during the spring or fall requires less water with high survival rate.
- Organic manure improves water-holding capacity of soil. Mulch acts as a blanket to keep moisture in and helps prevent erosion, soil compression and weeds.



In the kitchen, do not wash vegetables in running water. Use sprinklers in garden.

- Check for and repair leaky hose connections and sprinkler valves.
- Porous paving materials such as brick, granite or gravel help keep water in the garden.
- Water from kitchen and bathing areas should be recycled, treated and used in gardens and parks. Delhi Jal Board's Greenhouse Model Policy provides subsidy in establishing recycling mini plant.

In the Kitchen:

- Do not leave the water running while washing the dishes. Better to use two buckets, one for washing and another for rinsing the dishes. Use dishwasher only when full. Dishwasher uses as much as 50 liters of water in each complete cycle.
- Do not wash vegetables and fruits in running water. Use a small bucket.





Pollution around water bodies should be avoided

Municipal wastes should not be dumped in the open.

the total Yamuna pollution. More than 50% (384 MGD) of Delhi's total domestic sewage (710 MGD) is discharged untreated into the Yamuna.

Schemes Undertaken

A number of steps have been taken by various agencies to meet the city's water needs such as:

1. Dual pipe supply system
2. Zero run-off drainage
3. Recycling waste water
4. Regulating ground water extraction
5. Checking water theft and
6. Pollution control.

A number of programmes were taken up to address the issues:

1. Installation of Sonia Vihar water treatment plant to supply 140 MGD water to South and East Delhi,
2. Cementing of 'kachcha' Munak canal to save 80 MGD water for water treatment plants at Bawana, Okhla and Dwarka,
3. Construction of Renuka dam in Himachal Pradesh to provide 275 MGD water to Delhi,
4. Kishan dam and Lakhwar Vyasi dam in Uttaranchal to provide 275 MGD and 135 MGD water respectively,
5. Installation of 4 water recycling plants for utilizing 40 MGD water which otherwise is discarded as waste

water generated during water treatment operations,

6. Construction of 50 underground reservoirs to augment water supply and

7. DJB's Interceptor Sewage Technology project to clean the Yamuna.

However, in spite of the innumerable policies and programmes during the last two decades, there seems to be no respite in the water crisis. The primary reason for this sad state of affairs is that we simply talk of water conservation techniques, judicious use of water and recycling techniques but we never practice. The present water crisis is our own creation.

According to an estimate, we use more than three times the quantity of

Illegal booster pumps draw heavily from the underground aquifers



water than is actually required. Delhi may become a city of acute water scarcity if water related issues are not addressed in a focused manner. All efforts should aim at sustainable development and quality improvement of water resources.

Rainwater harvesting, groundwater recharge, judicious use of water, avoiding water waste and recycling of wastewater are important steps to address the water crisis. There is a need for participatory approach (both individual and community based) with financial assistance from the government, NGOs and other institutions. Available resources should be captured and used efficiently for maximum benefits.

Community Based Approach

Conservation of the most essential and priceless resource – water – should be made the focus of community living. There is a lot that communities, colonies and even small *bastis* can do to conserve water and utilize it efficiently. Some of these are:

■ Harvesting rainwater from rooftops, from run-offs of local catchments, seasonal floodwaters and local streams. Roof top rainwater harvesting should be made mandatory in every house and colony.

■ Repair, renovation and restoration (RRR) of water bodies. The water bodies should be cleared of encroachments.

■ Planting canopy of trees on both sides of the road and keeping central verge (of about 1 meter width) of road

Recycling of residential wastewater through water treatment plants should be made mandatory

The situation in India is disturbing because we have only 2.45% of the world's landmass to support 16% of the world's population.

■ Creating mass awareness about importance of water, its scarcity, conservation and efficient use through Jal Yatras, articles, shows on Doordarshan, talks on All India Radio, puppet shows, street plays and demonstrations about rainwater harvesting and artificial recharge to groundwater.

■ Organizing art and essay competitions and distribution of booklets, leaflets, folders on water conservation for school/college students.

■ Organizing training programmes for government officials, voluntary agencies and other professionals on water management.

■ Imparting timely information to DJB regarding leakage and bursting of pipelines in the city. Keeping watch on use of groundwater particularly by big commercial and industrial users.

■ Institution of an annual award for innovative practice on rainwater harvesting and artificial recharge.

The priceless resource of water can be considered limitless only if used in a sustainable manner. There has to be a national consciousness apart from individual conscience that should work to conserve water. For, that would make our lives only that much more easier and better.

Dr. K.P. Agrawal is Former National Coordinator, National Agricultural Innovation Project (NAIP), Indian Council of Agricultural Research (ICAR). Address: G-29, Brahma Apartments, Sector-7, Plot-7, Dwarka, New Delhi-110075; Email: kpa45@yahoo.com



Water bodies like lakes and baolis should be rejuvenated

kachcha for improving groundwater percolation.

■ Installing a hydraulic model, a satellite map of the pipelines for constant monitoring of pressure in the water system to prevent leakage.

■ Providing sewer lines in all the colonies to stop untreated sewage flow directly into the river.

■ Recycling of residential wastewater through water treatment plants. Installation of wastewater recycling system in all non-residential buildings having a discharge of 10,000 liters per day should be made mandatory.

■ Replacing rusty iron pipes and leaking pipe lines with leak proof PVC pipes.



Communities should go in for rainwater harvesting

■ Empowering local bodies to manage water distribution.

■ Ensure that the water that drains into the water bodies is properly treated before its release.

■ Municipal wastes should not be dumped in the open. The sewage and industrial effluents should be allowed into the Yamuna only after treatment.

■ Introduction of appropriate technology to ensure efficient use of water in the cooling process, controlling pollution, maximizing recycling and reuse. Insist on the use of water-efficient devices.

■ Introduction of drip and sprinkler irrigation for agricultural lands, parks and gardens.

■ Compulsory installation of water meters in residences. Also introduce competitive water prices, so those consuming more have to pay more.

■ Legal action on misuse of water (illegal tapping, theft, use of water for wrong practices, using potable water for non-domestic purposes and on-line booster).

Water Quality Facts and Statistics



Global water pollution

- Everyday, 2 million tons of sewage and industrial and agricultural waste are discharged into the world's water. (UN WWAP 2003)
- The UN estimates that the amount of wastewater "produced" annually is about 1,500 km³. (UN WWAP 2003)

Human waste

- Lack of adequate sanitation contaminates watercourses worldwide and is one of the most significant forms of water pollution. Worldwide, 2.5 billion people live without adequate sanitation. (UNICEF WHO 2008)
- 70% of the people who lack sanitation worldwide, i.e. 1.8 billion people, live in Asia. (UNICEF WHO 2008)
- Sub-Saharan Africa is the slowest of the world's regions to achieve improved sanitation: only 31% of residents had access to improved sanitation in 2006. (UNICEF WHO 2008)
- 18% of the world's population, or 1.2 billion people (1 out of 3 in rural areas), defecate in the open. Open defecation significantly compromises quality in nearby water bodies and poses an extreme human health risk. (UNICEF WHO 2008)
- In Southern Asia, 63% of rural people – 778 million people – practice open defecation. (UNICEF WHO 2008)

Human health impacts

- Worldwide, infectious diseases such as waterborne diseases are the number one killer of children under five years old. More people die from unsafe water annually than from all forms of violence, including war. (WHO 2002)
- Unsafe or inadequate water, sanitation, and hygiene cause approximately 3.1% of all deaths worldwide and 3.7 % of DALYs (disability adjusted life years) worldwide. (WHO 2002)
- Unsafe water causes 4 billion cases of diarrhoea each year, and results in 2.2 million deaths, mostly of children under five. This means that 15% of child deaths each year are attributable to diarrhoea – a child dying every 15 seconds. In India alone, the single largest cause of ill health and death among children is diarrhoea, which kills nearly half a million children each year. (WHO and UNICEF 2000)

Impacts on the environment

- There has been a widespread decline in biological health in inland (non-coastal) waters. Globally, 24% of mammals and 12% of birds connected to inland waters are considered threatened. (UN WWAP 2003)
- In some regions, like the Mediterranean and Madagascar and other island groups in the western Indian Ocean, more than 50% of native freshwater fish species are at risk of extinction, and nearly one-third of the world's amphibians are at risk of extinction. (Vie et al. 2009)
- Freshwater species have faced an estimated extinction rate five times greater than that of terrestrial species. (Ricciardi and Rasmussen 1999)
- Freshwater ecosystems sustain a large number of identified species, including a quarter of known vertebrates. Such systems provide more than US\$75 billion in goods and ecosystem services for people, but are increasingly threatened by a host of water quality problems. (Vie et al. 2009)

Drinking water quality

- Point-of-use drinking water treatment through chlorine and safe storage of water could result in 122.2 million avoided DALYs (Disability Adjusted Life Years, a measure of morbidity), at a total cost of US\$ 11.4 billion. (UN WWAP 2003)
- Nearly 70 million people living in Bangladesh are exposed to groundwater with arsenic above WHO recommended limits of 10 ug/L. (UN WWAP 2009)
- Naturally occurring arsenic pollution in groundwater now affects nearly 140 million people in 70 countries on all continents. (UN WWAP 2009)

Pollution from industry and mining

- 70% of untreated industrial wastes in developing countries are disposed into water where they contaminate existing water supplies. (UN-Water 2009)
- An estimated 500,000 abandoned mines in the U.S. will cost \$20 billion in management and remediation of pollution; many of these sites will require management in perpetuity. (Septoff 2006)
- In the U.S. state of Colorado alone, some 23,000 abandoned mines have polluted 2,300 km of streams. (Banks, et al. 1997)

- Chlorinated solvents were found in 30% of groundwater supplies in 15 Japanese cities, sometimes ending up as much as 10 km from the source of pollution. (UNEP 1996)
- Roughly one unit of mercury is emitted into the environment for every unit of gold produced by small-scale miners. A total of as much as 1000 tons of mercury is emitted each year. (UNEP/GRIDArendal 2004)

Pollution from agriculture

- In comparison to domestic, industrial, and agricultural sources of pollution from the coastal zone of mediterranean countries, agriculture was the leading source of phosphorus compounds and sediment. (unep 1996) nutrient enrichment, most often associated with nitrogen and phosphorus from agricultural runoff, can deplete oxygen levels and eliminate species with higher oxygen requirements, affecting the structure and diversity of ecosystems.
- Nitrate is the most common chemical contaminant in the world's groundwater aquifers. (Spalding and Exner, 1993)
- Mean nitrate levels have risen globally by an estimated 36% in global waterways since 1990, with the most dramatic increases seen in the eastern mediterranean and africa, where nitrate contamination has more than doubled. (Gems 2004)
- According to various surveys in india and africa, 20-50% of wells contain nitrate levels greater than 50 milligrams/litre and in some cases, as high as several hundred milligrams per litre. (cited in FAO 1996)

Groundwater impacts

- In Chennai, India, over-extraction of groundwater has resulted in saline groundwater nearly 10 km inland from the sea and similar problems can be found in populated coastal areas around the world. (UNEP 1996)

Infrastructure affects water quality

- 60 % of the world's 227 biggest rivers have interrupted stream flows due to dams and other infrastructure. Interruptions in stream-flow dramatically decrease sediment and nutrient transport to downstream stretches, reducing water quality and impairing ecosystem health. (UN WWAP 2003)

Courtesy: UNEP

Are You Ready for the “Medi-Soup”

S. BHANUMATI, SHYAM S. SHUKLA & ALKA SHUKLA

DO you ever wonder what happens to the medicines that you take for headaches, ulcers, infections, depression, and epilepsy? Does the body use all of the medicine that you take and, if not, where does the unused portion of the medicine go?

Well, the portion used by the body is metabolized to something else. Both unused medicines and their metabolites are excreted to eventually appear together in our water systems. The unused (surplus or expired) medicines that we dump also appear in our ecosystem. The water thus becomes a medi-soup. Would you want to drink water that contains all these medications together?

No information exists that can tell us the cumulative effects of a cocktail of medicine taken together, each even existing below its lethal dose. Also, the wastewater generated during the manufacturing process (containing substantial quantities of various medicines) may be dumped in our water systems. The bottom line is that the water is not only infested with traditional pollutants but also contains a host of pharmaceuticals. The

awareness does not exist that such medi-soup exists, and the import and the potential consequences of the pharmaceuticals in water are not very well known.

The pharmaceutical industry is one of the worst polluting industries when compared on the basis of the unit quantity (such as kilogram) of the product it produces. According to some estimates, up to 2000 kg of dangerous solvents could be generated per kilogram of the product produced. There are various reports that this industry has failed to take adequate precautions to curb its products from getting into the public water streams.

The extent of the pharmaceutical pollution in India is horrifying. We should not forget that India is the so-called medicine-basket of the world for specially the bulk medicines. The mass production of medicines creates a huge stream of effluents. The effluents, if improperly treated, contaminate water bodies and leave a cocktail of medicines. Nobody in the right mind and sense would like to consume 10-20 different kinds of medicines together but that is what the pharmaceutical-contaminants offer you in the drinking water.

Granted that the levels of individual pharmaceuticals may be low but one is simply ignorant as to the contraindications or the interactive toxicity of various medicines when taken together. A bunch of medicines taken together may cause a disaster that far exceeds the harm caused by any individual medicine.

‘Nocebo’ and ‘nocebo effect’ are terms that became popular in the 1990s and can be thought of as opposite to placebo effect. According to Root-Bernstein, “research has...shown that the nocebo effect can reverse the body’s response to true medical treatment from positive to negative”. Could this cocktail of medicines cause nocebo effect and induce or promote a disease where none existed before? What about children? What harm this medisoup will do to our generations, and the youngsters who are the future of our nation?

The other source of drug-laced water is through unmetabolised drugs being excreted by humans (and also animals). Since humans and animals are pretty evenly distributed throughout the land, the pharmaceutical pollution is likely to

be distributed through the land. Thus the problem assumes far greater proportions. The current water treatment facilities, even in the developed countries, are still in the advancing stage. Scientists, lawmakers, and the community at large are neither well aware of the enormity of these problems nor are they prepared to handle these yet.

An integral step for most of the current water treatment facilities is disinfection using chlorination or ozonation. All of these processes use very reactive chemicals and a major concern is the formation of disinfection by-products (DBPs). For the case of chlorination, the DBPs in water are carbon tetrachloride, chloroform and other similar compounds. Though they are present in small quantities their toxicity is much greater, making the problem very serious and difficult. Now, if pharmaceuticals are also present in the water, they themselves are likely to result in the formation of their own series of products, making an even worse cocktail of chemical compounds. The effect of such cocktail on human and animal well being is impossible to predict.

A fourth source of pharmaceuticals in water is dumping of surplus and expired medicines in municipal waste. This problem can be easily rectified by increasing awareness of the serious consequences of discarded medicines on the environment and people and animals, and plants that inhabit this planet.

Finally, a totally unexpected but a truly scary result of pharmaceutical pollution is the rise in drug-resistant bacteria. It is easy to see that the bacteria that survive the effect of the medisoup, will likely be much more drug resistant. Globally, the drastic rise of bacterial resistance to the well-established antibiotics poses a serious concern. Many studies have begun to appear in scientific literature that seem to support this view.

For a country like India that is so densely populated, the spread of infection through drug-resistance could cause massive damage to the society and the country. According to the *Wall Street*

Journal, "India has 41 cities with more than 1 million people. The rapid growth of these megacities is overwhelming but with poor municipal services, leaving many with mounds of rotting trash, sewage flowing directly into polluted rivers."

In such a situation any additional burden of infectious disease is likely to have monumental consequences. Also, there are several systems offering treatment for any disease. To name a few: Unani, Ayurved, homeopathy, herbopathy, and naturopathy all use medications in their own ways. Aquatherapy directly uses water as a therapeutic agent. Imagine the results if the very water is contaminated.

Improper water treatment can let the drugs easily get into the treated water, which in turn may be recycled as potable water to sicken the masses afresh. Most water treatment methods are not efficient enough to remove the micro levels of drugs that seep into water systems through direct, indirect and unexpected routes.

What To Do?

Strict controls and checks can be placed at the production stage. The industry and health providers should be required to administer proper disposal of the surplus and expired materials. Perhaps much more sophistication in the analytical instruments will help in detecting and handling, but this is a cost intensive exercise.

So, what should a common (layman) do?

- Stop drinking water (really???)
- Buy expensive water filters/purifiers
- Buy an RO Unit
- Take regularly detox pills
- Compromise with what is available
- Improvise a set-up to one's own satisfaction

The last option seems to be more realistic in our Indian context. A number of cost-effective and low tech (CELOT, coined by the authors) options are being studied, experimented, and evaluated in laboratories both in India and the US.

The problem is monumental and the solution cannot be tailor made. We can never totally eliminate the risks but we can always reduce their intensity by meticulous planning. Of course, consumers are the end users

The other source of drug-laced water is through unmetabolised drugs being excreted by humans (and also animals).

Don't throw unused medicines in the drain



but they could also be a part of the problem and also a part of the solution. If they realize the severity and the consequences of the medisoup in water they can also mitigate the severity of the problem by maintaining a strong civic sense.

The public could play an active watchdog role by:

- Avoiding purchase of medicines in excess of their need
- Avoiding overdose of medicines
- Avoiding throwing excess or expired medicines in trash bins or flushing them down in the sewer system.

The best way to discard the excess medicines is to put them in the transparent (for safety reasons) medidrop containers installed at strategic points by municipal corporations or through periodic door-to-door collection by genuine volunteers from registered social work groups or NGOs. An attempt is being made through organizations just to do this work in major metros of India.

Much of the present day malady is the result of human intervention in nature's functions in a disproportionate ratio. Man alone can find appropriate solutions for solving this problem.

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New Variety of Turmeric

Agriculture scientist Prof P. S. Vashi and his colleagues working in the Department of Botany, at the Navsari Agriculture University in Gujarat have developed a new variety of turmeric, which is resistant to diseases and yields higher yield of turmeric with better curcumin content. The variety is known as NAU Turmeric 1. Curcumin is the coloring principle of turmeric. It is extracted as an orange yellow crystalline substance.

The scientists have been carrying out research over the last six years to develop a variety of turmeric that could be grown in South Gujarat, which receives a heavier rainfall compared to North Gujarat. Heavy rainfall creates problems of waterlogging resulting in the collapse of the plant and decay of rhizomes. Turmeric plant has rhizomes.

The yield and curcumin content of the NAU Turmeric 1 is better than locally grown varieties. The new variety has a yield of 35-40 tonnes per hectare while the traditional variety has a yield of 15-20 tonnes per hectare only. Also the curcumin content that determines the quality of turmeric is better in the new variety.

Turmeric (*Curcuma longa*) is a rhizomatous plant of the ginger family. It is native to tropical South Asia. Plants are gathered annually for their rhizomes, and re-seeded from some of those rhizomes in the following season. The rhizomes are boiled for several hours and then dried in hot ovens, after which they are ground into a deep orange-yellow powder (*Haldi*) commonly used as a spice in curries and other South Asian and Middle Eastern cuisine, for dyeing, and to impart color to mustard condiments.

Its active ingredient is curcumin and it has a distinctly earthy, slightly bitter, slightly hot peppery flavor and a mustardy smell. Turmeric has many medicinal properties and is used as a readily available antiseptic for cuts, burns and bruises. It is also used as an antibacterial agent. Turmeric is currently being investigated for possible benefits in Alzheimer's disease, cancer, arthritis, and other disorders.

Contributed by Mr G. V. Joshi, E/2-11 Girijashankar Vihar, Karvenagar, Pune, 411052.

Eco-Friendly New Age Bio-Chips

Researchers at Rensselaer Polytechnic in Troy, Berkeley and Solidus Biosciences in USA have developed biochip technology that promises to reveal the potential toxicity of chemicals and drug candidates during early experiments.

A biochip, also called DNA chip or DNA micro-array technology, allows rapid and simultaneous screening of many thousands of genes in a single experimental process. The new age biochip developed by the researchers is known as metachip and datachip that mimic what the body does when it ingests a drug in addition cutting costs and eliminating the need of animals for drug testing.

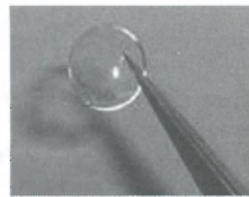
A metachip is usually made up of a glass slide dotted with 20-nanoliter droplets of a solution containing human liver enzymes, while a datachip is made up of a glass slide lined with droplets containing cell cultures from the kidney or bladder. The bright side of these biochips is that a researcher can test potential toxicity of compounds by introducing these compounds into the solution in the form of droplets and seeing the reaction.

Researchers say this new age eco-friendly biochip will not only reduce the cost of developing new drugs, but also stop killing of a large number of animals needlessly subjected to potentially toxic substances. These data chips can also be expanded to include the different cell types representing different organs like cardiac, neural and skin cells with its major implementation in cosmetic industry to identify toxicity of certain chemicals before they can cause allergic reactions or irritations on candidates of certain skin types.

Contributed by Shri Rahul Rohitashwa, Secretary, Earth Matters Nature Club, Flamingo Vihar, Laheri Tola, Bhagalpur-812002, Bihar

Diabetics to Benefit from Colour-changing Contact Lenses

There is good news for diabetics. A revolutionary technology is on its way that will monitor their blood sugar levels so that daily measurement of their blood sugar levels by drawing blood would no longer be necessary.



The diabetic patients will soon be able to wear contact lenses that will continuously monitor the changes in their blood sugar levels. These changes will be indicated by the changing colours of the contact lenses worn by them.

Jin Zheng, professor of biochemical engineering at the University of Western Ontario in Hamilton near Toronto, is the chief architect behind the development of this new, revolutionary technology.

This non-invasive technology uses extremely small nano-particles that are embedded into the hydrogel contact lenses. These nano-particles react with the glucose molecules found in tears, causing a chemical reaction that changes the colour of the contact lenses.

According to Jin Zheng, this technology may have other potential applications beyond biomedical devices too. For instance, it can be used for food packaging applications. The nano-composite film can prevent food spoilage by preventing oxygen, carbon dioxide and moisture from reaching the foodstuffs thus maintaining their freshness.

Contributed by Dr P.K. Mukherjee, 43, Deshbandhu Society, 15, Patparganj, Delhi-110092

New Scorpion Species Discovered in Mumbai Suburbs

A new species of scorpion has been discovered in the green belt of Aarey Milk Colony in the far western suburbs of Mumbai. Discovered by two college-going students, it is a significant finding that could throw further light on the biodiversity and ecosystem of the Western Ghats.

The discovery has been made by Zeeshan A. Mirza, currently pursuing a Bachelors degree in science from Bhavan's College at Andheri and Rajesh V. Sanap, studying Bachelors degree in arts at Goregaon's Patkar College.

The new scorpion has been named *Lychas aareyensis* sp. nov. and the collection, after identification, has been deposited with the Bombay Natural History Society (BNHS).

"The biodiversity in the Aarey Milk Colony is rich. This needs to be protected. There could be several other species here that may have not been discovered till now," says Mirza. "We first saw the scorpion a few years ago and then subsequently started research...and now our findings have been published," he said.

Mirza said that he has recorded scorpions with the maximum size of three centimetres. He said that the group has a different sting. "Moreover, the hairs of this species are sensitive," he shares his findings.

Asked how a layman could identify this scorpion, Mirza says: "There is not much awareness among the people about scorpions. We either know a black scorpion or a



Land Wars

It is not only humans who indulge in violent land grabbing. A 10-year study of a chimp community in Uganda has found that bands of chimpanzees violently kill individuals from neighbouring groups in order to expand their own territory.

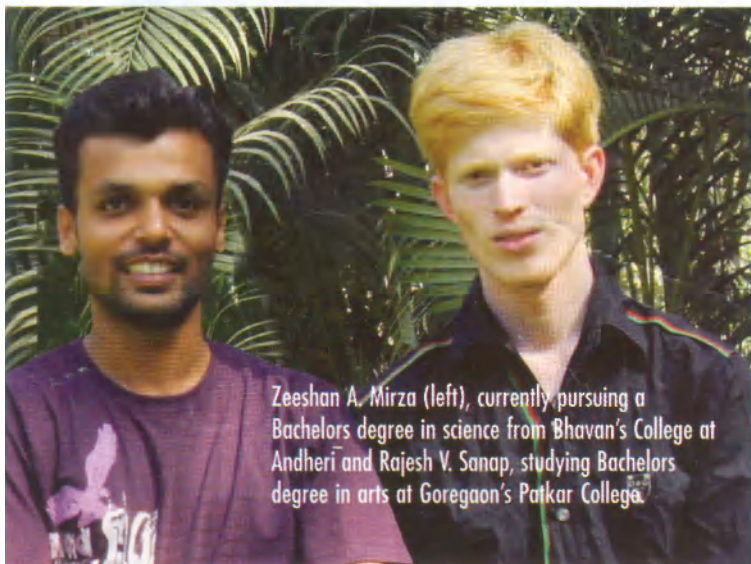
University of Michigan primate behavioural ecologist John Mitani's findings are published in the June 22 issue of *Current Biology*.

During a decade of study, the researchers witnessed 18 fatal attacks and found signs of three others perpetrated by members of a large community of about 150 chimps at Ngogo, Kibale National Park.

Chimpanzees are humans' closest living relatives. Anthropologists have long known that they kill their neighbours, and they suspected that they did so to seize their land but until now clear-cut evidence was not available. The bouts occurred when the primates were on routine, stealth "boundary patrols" into neighbouring territory. In most of the attacks in this study, chimpanzee infants were killed perhaps because infants are easier targets than adult chimpanzees.

Scientists are still not sure if the chimpanzees' ultimate motive is resources or mates. They haven't ruled out the possibility that the attacks could attract new females to the Ngogo community. The scientists say these findings disprove suggestions that the aggression is due to human intervention.

Lethal attacks were first described by renowned primatologist Jane Goodall who, along with other human observers, used food to gain the chimps' trust. Some researchers posited that feeding the animals might have affected their behaviour.



Zeeshan A. Mirza (left), currently pursuing a Bachelors degree in science from Bhavan's College at Andheri and Rajesh V. Sanap, studying Bachelors degree in arts at Goregaon's Patkar College.

brown scorpion. But there is more to the world of scorpions."

"The description of *Lychas aareyensis* sp. nov. brings the total number of *Lychas* species in India to 14. A new species of scorpion from a city like

Mumbai highlights our lack of knowledge on Indian scorpions," Mirza and Sanap wrote in their research paper, which has been published in the *Journal of Threatened Taxa* in April.



The new scorpion has been named *Lychas aareyensis* sp. nov.

They have also pointed out: "A detailed survey conducted by us indicates that the area is rich with respect to its biodiversity but is poorly documented. Direct threat to this species includes clearing of forest for agricultural purpose and for bootlegging activities.

Plantation of exotic trees has contributed towards destruction of habitat, as they are incapable of holding soil and too weak to withhold the monsoon showers that lead to soil erosion. Additionally, forest fires cause maximum damage to this and other ground dwelling species."

Contributed by Mr Mrityunjay Bose who works with *Sakaal Times* as its Special Correspondent in Mumbai. Address: 102, A-Wing, VK Tower, Evershine City, Vasai (East), Thane District-401208, Mumbai. E-mail: mrityunjaybose@gmail.com

Zebra Finches

When zebra finches learn their songs from their father early in life, their brain is active during sleep. That is what biologists at Utrecht University conclude in a paper published in the *Proceedings of the Royal Society B*. Their findings are a further demonstration that birdsong learning is very similar to the way children learn how to speak.

This discovery has important consequences for our understanding of the brain processes involved in learning and memory. Human infants learning to speak show increased

activation in a part of the brain that is comparable to that studied in young zebra finches. Furthermore, language learning in children is improved when they are allowed to take a nap. The Utrecht discovery will increase our understanding of the role of sleep in the formation of memory.

Previously the researchers, Sharon Gobes, Thijs Zandbergen and Johan Bolhuis, had demonstrated that the way in which zebra finches learn their songs is very similar to the way in which children learn to speak. In both cases learning takes place during early youth and involves considerable practise. Also, in children and songbirds alike, different brain regions are involved in learning and in speaking or singing. The new research shows that, just as in human infants, the brain of the young zebra finch is also active during sleep. This makes songbirds a good animal model to study the role of sleep in human speech acquisition.

It has been known that sleep plays an important role in learning in humans and other mammals. In songbirds it had been shown previously that during sleep the brain has the same pattern of activity as during singing the day before. The present findings show that the more young songbirds have learned from their father's song, the more active their brain is during subsequent sleep.

Human Protein That Prevents H1N1 Identified

A naturally occurring human protein that helps prevent infection by H1N1 influenza (or Swine flu) and other viruses including West Nile and dengue virus has recently been identified by scientists

Stephen Elledge, associated with the Howard Hughes Medical Institute, working in collaboration with his colleague Abraham Brass discovered that human cells respond to infection by the H1N1 influenza virus. As a result, proteins having unexpectedly powerful antiviral effects are produced in the body. The two scientists found a small family of flu-fighting proteins called interferon-inducible transmembrane proteins that have the effect of boosting the body's defence mechanism to viral infection

News Briefs

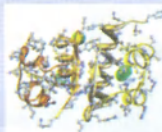
■ Scientists are reporting new evidence that drinking coffee may help prevent diabetes and that caffeine may be the ingredient largely responsible for this effect. The link between coffee and diabetes risk appears to be consistent across different ages and body



weights; in addition, most research has found that the more coffee an individual generally drinks, the lower his or her risk for diabetes. Coffee also causes some other beneficial changes in the fatty liver and inflammatory adipocytokines related to a reduced diabetes risk.

■ A team of researchers has found that early hominids ate a wider variety of foods than previously thought, including fish and aquatic animals such as turtles and crocodiles. Rich in protein and nutrients, these foods may have played a key role in the development of a larger, more human-like brain in our early forebears around 2 million years ago. Cut marks found on the bones indicate that the hominids used simple, sharp-edged stone tools to butcher their prey.

■ The world's largest DNA scan for familial autism has uncovered new genetic changes in autistic children that are often not present in their parents. Identified in less than 1% of the population, these rare variants occur nearly 20% more in autistic children. Two striking things were discovered: first, the rare variants interfered nearly 20% more in the genes of autistic children than in the healthy children. Second, a number of disruptions were found that are new.



■ There's a potential threat lurking in the Internet cafe, say researchers. It's called Typhoid Adware and works in similar fashion to Typhoid Mary, the first identified healthy carrier of typhoid fever who spread the disease to dozens of people in the New York area in the early 1900s. Adware is a software that sneaks onto computers often when users download things, for example fancy tool bars or free screen savers, and it pops up lots and lots of ads. Typhoid adware needs a wireless Internet cafe or other area where users share a non-encrypted wireless connection.

■ Defects in insulin function — which occur in diabetes and obesity — could directly contribute to psychiatric disorders like schizophrenia. Investigators have discovered a molecular link between impaired insulin signaling in the brain and schizophrenia-like behaviours in mice. The findings offer a new perspective on the psychiatric and cognitive disorders that affect patients with diabetes and suggest new strategies for treating these conditions.

■ Due to climate change vegetation around the world is on the move, according to a new analysis of global vegetation shifts. Researchers present evidence that over the past century vegetation has been gradually moving toward the poles and up mountain slopes, where temperatures are cooler, as well as toward the equator, where rainfall is greater. Moreover, an estimated one-tenth to one-half of the landmass on Earth will be highly vulnerable to climate-related vegetation shifts by the end of this century.

■ Common drugs used to treat diabetes and obesity could be used to successfully treat hepatitis C virus infection. Researchers have found drugs such as anti-diabetic drug Metformin and AICAR, used to combat obesity, can prevent the hepatitis C virus from replicating in the body. Hepatitis C virus affects the liver and recovery rates are low: only around 40% of hepatitis C sufferers will fully recover, with others developing cirrhosis and in many cases, liver cancer.

M. V. SUBBARAO

Shoring Underground Water Reserves

With taps running dry and erratic rainfall patterns, the coming years will witness extreme water shortage. Shoring up underground water reserves could play an extremely important role in warding off extreme water scarcity in the near future.

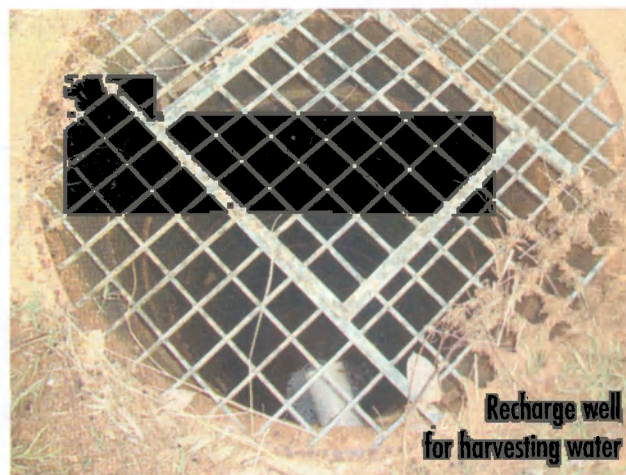
WITH water scarcity slowly becoming the order of the day, management of water resources has assumed gigantic proportions. This has become extremely important not only to meet the increasing water needs but also to reduce the flood hazard.

The problem of water scarcity will be especially apparent in semiarid and arid parts of the world, where water is or soon will be in short supply. In some areas, location of new supplies is unlikely and serious consideration is being given to ideas as original as towing icebergs to coastal regions where fresh water is needed. It seems apparent that water will become much more expensive in the future and if the price is right, many innovative programs are possible.

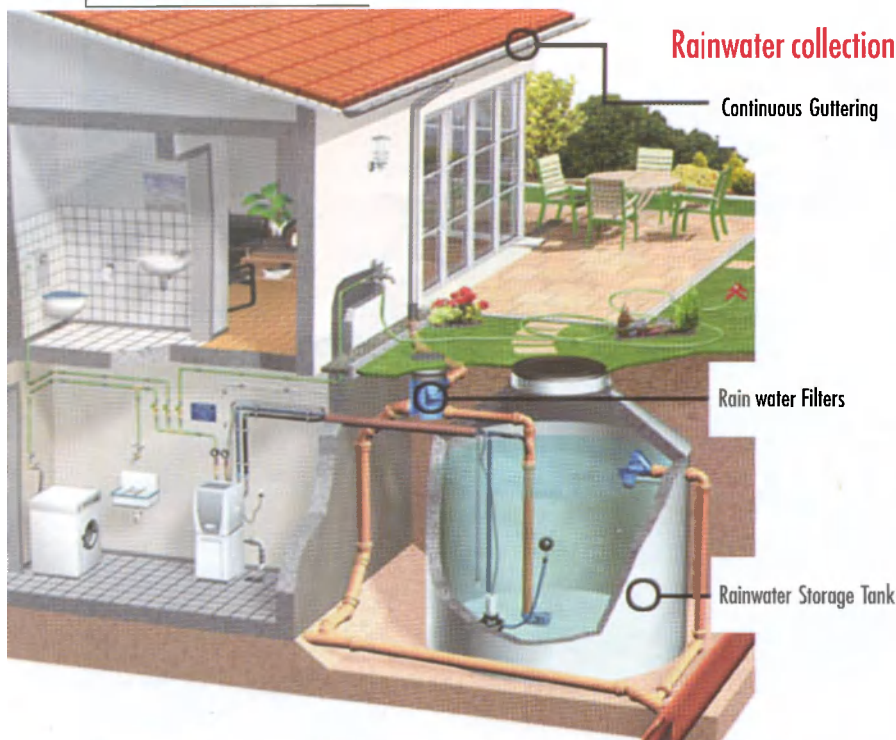
Luna Leopold (1991) suggests that a new philosophy of water management is needed – one based on geologic, geographic and climatic factors as well as the traditional economic, social and political factors. He argues that the management of water resources cannot be successful as long as it is natively perceived from an economic and political standpoint. However, this is in fact how water use is approached. (The term water use is appropriate because we seldom really manage water.)

According to Leopold's philosophy, surface water and ground water are both subject to natural flux with time. In wet years, there is plenty

of surface water and the near surface groundwater resources are replenished. During these years we hope that our flood control structures, bridges and storm drains will withstand the excess water. Each of these structures is designed to withstand a particular flow that, if exceeded, may cause damage or flooding.



Recharge well for harvesting water



It seems apparent that water will become much more expensive in the future and if the price is right, many innovative programs are possible.

Underground Water Storage



When dealing with groundwater that is naturally replenished in wet years, we should develop plans to use surface water when available and we should not be afraid to use groundwater as needed in dry years; that is, the groundwater might be pumped out at a rate exceeding the replenishment rate in dry years. During wet years natural recharge as well as artificial recharge (pumping excess surface water into the ground) will replenish the groundwater resources. This water management plan recognizes that excesses and deficiencies in water are natural and can be planned for.

Underground Water Storage

But one thing is certain. In the looming days of extreme water scarcity, underground water storage could play an important role. Artificial recharge of ground water does not require any extra space and cost for storage. If properly operated, unlike surface reservoirs, the underground reservoirs can be used for infinite period. Underground water storage reservoirs are also free from adverse effects of natural catastrophes.

While artificial recharge improves the quality of ground water, rainwater harvesting reduces the urban runoff thus avoiding inundation of low-lying areas. Often the entire rainfall gets converted into surface run-off and the valuable resource is allowed to join the sea after inundating the low-lying areas.

Various recharge techniques can be employed to harvest the entire rainwater and fill the natural reservoir available in the underground. The sub-soils of urban areas are well suited to recharge the aquifers through rainwater harvesting.

Recharge well with dimension of 1 m diameter and 5 m depth and 0.5 m sand filter at the bottom is suggested in each house of 150 to 200 m² roof top area. The design of the recharge well is arrived at by studying the permeable capacity of the soils and hourly intensity of rainfall. A trench of 0.5 m width and 1 m depth is made parallel to the compound wall and filled with filter media where the surface run-off is accumulated so that the rainwater other than the roof area is also collected into it.

Water Act

The Water (Prevention & Control of Pollution) Act, 1974, provides for the prevention and control of water pollution and maintenance/restoration of wholesomeness of water in wells, streams, watercourses, inland water, subterranean water and sea/tidal waters to an extent of 5 km from the shoreline. It is obligatory on the part of industries and local bodies to seek and obtain the consent of Pollution Control Board in any state, to discharge trade effluents/domestic sewage within the quality/quantity standards set up, as measured by various parameters. In the event of failure to do so, the parties are punishable under certain provisions of the act, irrespective of their size or pollution potential.

It has been concluded that at least 0.9 to 1.0 m³ water per year can be conserved from each square meter of a house if proper conservation techniques are followed. This conserved water can sustain for 20 to 25 years and does not require any maintenance. If every household of the city implements this method we can depend upon our ground water source for the entire domestic needs.

Community Conservation

Community associations can play a major role in water conservation. In addition to reducing the water used for landscaping, associations and homeowners can decrease water consumption in their buildings, homes and common areas. Conservation of water can also help relieve waterlogged budgets. There are several examples where associations throughout the country have used water conservation to save money while conserving a precious resource.

Proper management and correct use of climate, plants and soils can also

reduce water use. In many community associations, landscape problems have reached alarming proportions. And budget to reverse the situation is limited and strained. A cost-effective solution to these problems is Xeriscape. Xeriscape is the planned and wise use of climate, plants and soils to create efficient, beautiful outdoor spaces and landscape that uses less water. Simply put, Xeriscape means appropriate horticulture.

Xeriscape begins with a water and landscape master plan. The master plan should provide the association with an outline to properly manage the landscape water consumption and to create more efficient and extensive greenbelts. The master plan addresses existing conditions, goals, policies and procedures, irrigation scheduling, pruning and fertilization practices, pest and disease control and all other aspects of proper long-term management of a landscape. All stakeholders should play a role in creating the master plan, including the contractor, the property manager, the house owners and the experts who may be hired.

There are seven basic guidelines provided by the National Xeriscape Council, Inc., a nonprofit organization that helps coordinate efforts centered on the Xeriscape approach. The steps are simple but effective in helping to reduce irrigation requirements while increasing greenbelt canopies.

1. Planning and Design: Good planning and design of the landscape and maintenance programs create the starting point of any successful Xeriscape application.

2. Soil Test: When choosing plants, soils must be carefully considered. Soils vary from site to site and even within a given

site. The Xeriscape solution to the problem is that the soils are managed to accommodate the plants that will grow well in these soils, rather than trying to change the soils.

3. Appropriate Plant Selection: Select plants that are suited to the area in which they will grow. Do not attempt to grow ferns in hot sun and do not put sun-loving plants in the shade. Plants should be grouped in accordance with their respective water needs.

4. Practical Turf Areas: Use turf primarily where it will serve a function, not merely for aesthetic purpose. Find practical areas for using turf. Consider using warm season grasses where turf seems appropriate.

5. Efficient Irrigation: Design or alter irrigation systems to accommodate the water needs of the plants and soils. Use the particular type of system that best meets these needs with greatest efficiency and manageability. Water plants only when they need water.

6. Use of Mulches: In dry areas where water readily evaporates from soils, apply layer of soil surfaces. This helps to reduce water evaporation and weeds.

7. Appropriate Maintenance: Develop and implement good programmes of maintenance and care for all landscape. Good long-term management and maintenance leads to water conservation.

The National Xeriscape Council, USA, gives five Xeriscape principles: Landscape functions, environmental fit, financial responsibility, fun and follow through. The principles are simple, extremely cost effective and can lead to considerably more attractive landscapes with fewer demands on manpower, equipment, chemicals, water and other resources. When properly applied, these principles can also significantly reduce irrigation related street, gutter and foundation damage.

Prof. M. V. Subba Rao, is President, Environmental Research Academy, #58, Seethammadhara North Extension, Visakhapatnam-530013, A.P.; Email: mvsubbarao_enra@yahoo.co.in

Keep the Water Clean

- Surroundings of water bodies should be kept clean.
- Care should be taken to prevent disposal of sewage and domestic or industrial waste into bodies of water.
- Proliferation of Eichornea (water hyacinth), Pistia and algal bloom on water must be avoided.
- Fish and turtles should be introduced into water bodies to purify the water.
- Wells should be kept open to allow fresh air and sunlight to act as a natural sterilizing agent on the surface of the water.
- Wells and tanks must be desilted regularly.
- Washing of clothes, vessels, cattle and automobiles should be prohibited at public tanks, lakes etc.

"Keeping Animals in Zoos is Unethical."

Most Inhuman

A Zoo is no longer a learning place—it is just like any other picnic spot or a hangout. You



go there, have your share of fun and leave behind the garbage. Then you come home and talk big on ways and means of prevention of cruelty to animals. The moot question is why to keep the animals in Zoos at all?

You want to study about wildlife? Go and learn about it in their natural habitat. These animals will show their natural traits only in their natural surroundings. If you keep them in the Zoo for study purposes, please keep in mind that your observations will be totally distorted.

You talk big about liberty. Liberty is a two-way traffic. You need to respect the liberty of others, before you talk of enjoying your own liberty. Displacing animals from their natural habitat and keeping them captivated in the Zoo is most inhuman. This disturbs the order of Nature. You are doing no service either to wildlife or to humanity by displacing them from their roots.

How can we have laws like 'Prevention of Cruelty to Animals' on the one hand and captivated animals in Zoos on the other hand?

Gaurav Sharma

X-B, Bai Bharati Public School,
Ganga Ram Hospital Marg, New
Delhi

Necessary for Saving Them

Keeping animals in zoos is not unethical. It becomes unethical when the animals are deprived from proper facilities and are not maintained well. Sometimes keeping an animal in zoo becomes necessary to save it from extinction and the animal thrives there comfortably.

Shayan Ghani

Patna, Bihar

For Entertainment & Earning

An emphatic NO. We do not feel pity for slaughtering them when we need proteins. We are not kind to them while we play polo or some other adventure sports. We are not ashamed of killing the defenceless animals for making medicines from their body parts. And we do have every right to kill them in the name of religion. So, what is unethical if we put them in zoos for doing some business? We should rather be grateful to zoos at least on two counts: for giving us entertainment and helping some families earn their livelihood.

Partha Sarkar

R.R & R Dept, Writers' Buildings
Kolkata

No Proper Treatment

Yes, keeping animals in zoos is unethical. These animals are captured so that they can be used to entertain the human society. Zoos and other botanical gardens usually become picnic spots. Animals are captured and kept in cages. These animals are being denied their normal lives. They are often kept hungry so that they can make noise and attract people. They are not given proper environment to live there own

life. It is becoming a common culture of every state, to make a big and huge zoo where animals are not given proper treatment.

Prafuliit B Saxena

Sahibabad, Ghaziabad

Free The Animals

I totally agree with the fact that keeping animals in zoo is unethical. Unlike human beings animals take birth in the natural environment and grow up in the lap of nature observing various natural phenomena thereby learning the rules of survival. If they are kept in a zoo, which is only a slight of copy of their natural environment, probably they will not show their natural behavior. A Cheetah can run at a very fast speed but we can't see it doing so in a cell of 100 sqft that is fenced all around. Lion is the king of forest, but his king-like behavior is not observable in a zoo. Basically, in a zoo the free movement of animal is restricted, consequently they lose their natural behavior that makes them what they are.

A zoo is mere showcase of animals, which is like nature's beauty has been captured in cages, just for amusement. One can see these helpless creatures. However we cannot interact with them and can never understand their social and personal life. Preserving these animals is necessary but why in a zoo? Why not in a sanctuary, which is probably closest to their home. Let's break the boundaries of the zoos and their fences, let's free them from cages and give these incredible creatures the best present that we can give – freedom.

Mritunjay Mishra

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Free Them to Strengthen Gene Pool

Zoos are ex situ conservation sites but these are not definitely the abode for the animals. It is seen that most of the animals in the zoos are highly stressed due



to many factors like unavailability of adequate amount of food, lack of proper space, lack of proper maintenance etc. Most of the exotic species are either kept alone where as in some place species population pressure is too much in a particular cage. It cannot be denied that zookeepers are not well trained to handle all animals in very scientific manners. It is very true that a specific demographic and climatic condition of a particular area cannot be an ideal habitat for most animals. Moreover, overcrowding by visitors and their unruly behaviour like teasing, mimicking etc makes animals frightened. Each and every animal should be free to live its own life in its own natural habitat. This will make their gene pool stronger.

Dr. Biswajit Kumar Acharjee

K V Dimapur, Nagaland

Spacious Enclosures

Zoo is a place where the fauna is conserved, protected and displayed for public knowledge. According to the rules set up by the government, the animals and birds are to be kept in spacious enclosures with the conditions therein simulating

Point Counterpoint

their natural habitats. If the zoos are set up according to these conditions, keeping animals in zoos is not unethical as they are protected from extinction.

Parasar H. Lenka
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Make Zoos Ethical

We all know that keeping animals in zoos is unethical but very few people raise their voice against it. Zoos are becoming very popular in every part of world. Many types of animals are kept in zoos for displaying to public. But zoos are not good for animals. Animals in the zoo miss their natural habitat.

The only way of making zoos ethical is to only keep endangered species in it for sometime for breeding and after that they should be released into wildlife sanctuaries and national parks. It is the necessity and need of time to awake and put in efforts to maintain ecological balance.

Parth Mahajan
Nurpur

Freedom is Important

Of course, keeping animals in zoos is unethical. Freedom is very important for all human beings, then why animals are



kept in cages? They should have their own habitat so that they can reproduce and survive easily in the zoos. Just imagine, if a man is kept in a locked house with all facilities only for a week, he can't live there because he needs freedom. Then, why animals are kept in cages, they also need freedom.

Abhijeet Anand
Patna, Bihar

Nothing Unethical!

On the face of it, keeping animals in zoos may sound unethical as animals are deprived of their



freedom and natural life style. However, to think realistically, there is nothing unethical about it as long as animals are provided with sufficient space and proper food. When killing thousands of cows, pigs, chickens etc. to protect ourselves from epidemics is not unethical, how can just keeping animals away from their habitat but with all possible facilities become unethical? In fact, animal's safety and health are well assured in the zoo as most of the zoos are staffed with qualified professionals. The zoo brings animals closer to man and there is no better way to appreciate the charm of wild animals, as every one cannot become a wild life photographer and venture into forests. One more advantage of keeping animals in zoos is that it helps to protect some endangered species, which otherwise would face the threat of extinction in their natural habitats. Considering these factors, I strongly feel there is nothing unethical in keeping animals in zoo provided they are given due care.

Dr. P. Venkata Rami Reddy
Sanjay Nagar, Bangalore

Unethical & Cruel

Zoos in my perspective are totally unethical and cruel. If we look at an animal, whether it's a cat or a dolphin, it has the same qualities as humans. They have a heart, a brain, and thoughts. If we were animals and had no way to speak up for our self, how would we feel? All day these animals are supposed to eat and sit, locked behind bars watching people watch them. Cages are



unpleasant as they snatch and steal the freedom of these creatures. For example, polar bears are given 30 feet of walking space, whereas in the Arctic they could roam freely for hundreds of miles. It is not justified to remove them from their home and family. Zoos are just another word for animal prison.

Kuldeep Singh, Etawah, U.P.

Zoo: An Absurd Idea

Zoo is a concrete jungle made to accommodate animals in cages where people visit these animals to know about their habitats. But isn't it foolish to remove an animal from its natural habitat, put it in cages and then try to know about its habitat, its hunting and living habits. It is just like shifting an Eskimo from his home to a desert and then trying to know about his fishing skills. Also, humans are not put in cages unless they commit a crime. But the person who himself has done a crime by putting these animals in the cages is roaming freely outside, visiting these animals often. The idea of putting animals in cages in zoos is not only unethical, but useless, absurd and a sheer wastage of money also.

Harkishan Dua
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Let Them Nautrally

It is often said: "Wild animals are beauteous in the forests, as the babies are on their mothers' laps." What for then, are they kept in cages? Is it for displaying the supremacy of humans? If intellect is the father of supremacy, conscience should be the mother. Where is the



application of conscience then, in confining the innocent animals? How would it be, if those who indulge in such practices are kept in cages likewise. Nature is ethically meant for the welfare of all species and not for Humans only. It also cannot be denied today that the human race emerged from the animals through a continuous process of evolution.

Animals in zoos are, in fact, being prevented from naturally roaming, hunting, mating and many more activities. Think how many crimes are committed in our human society when these activities are denied. One, therefore, can't encroach on other species' rights. Accordingly, keeping the animals in zoos is extremely unethical. Let them live naturally.

Anil Kr De, Hooghly (W.B.)

For their Own Good

It is wrong to think that keeping animals in zoos is unethical. Sometimes for their own good, protection or for breeding of endangered species zoos and rescue centers serve a definite purpose. One of the advantages of zoo confinement is that school-going kids get immense experience and understanding of the behaviour of exotic breeds. The authorities on their part, should strive to provide natural environment to the zoo-denzens. Zoos and sanctuaries can be a good source of revenue for the state/centre and the earnings can be ploughed back for the well-being of the zoo-inmates.

Dr Shiv Kumar
Jaipur



Extinction or Ethics?

The animal kingdom is an epitome of the grandeur and majesty of our planet. At first glance, keeping an animal in a zoo may seem unethical, even inhumane. However, one needs to make a clear distinction between reality and morality. In light of the current trends of deforestation, consequent habitat loss and overall loss of biodiversity, zoos offer a viable format of ex-situ conservation. Not only do zoos provide a safe haven for endangered species, giving them a shot at renewed life and growth, but also serve as excellent platforms for interaction between naturalists and species. Thus, by gaining an insight into the various nuances of an animal's life we can cater to its needs better and opt for a comprehensive conservationist approach. Of course, on the other side of the spectrum one can argue that by delocalizing an animal it is stifled and is subject to sudden changes in behavioral patterns. Moreover, the unwarranted attention of the visitors only adds fuel to the fire. However, we must realize that zoos also attune the general public to nature, sensitizing them and creating awareness and impetus for conservation. Here it's not a question of ethics rather it's a battle between life and extinction of the wild.

Shayer Majumdar
Chandigarh

For Their Care & Comfort

From earlier times till today, people and other rich fellowmen have been hunting wild animals for their valuable skin, teeth and other materials. Taking away all the animals from the forests may be a wrong thing because its original habitat may be lost. For example, one can take the example of Bandipur forests in Karnataka. In the year 2003, the number of tigers was only 58, but by this time probably it would have become the least. On observing all these facts how is it possible to say that keeping animals in zoos becomes unethical? When animals are facing the danger of extinction it would be right to go against the ethical values. When the zoos are providing so much of care and comfort it would probably be the right way of conserving the endangered animals.

Prathibha Raghavan
Mysore, Karnataka

Information for Humans

On earth, dominated by us human beings, it has become natural for animals to face trouble. Though animals are being protected in zoos mainly for the greater interest of the people, there are necessary provisions for the well being of animals in zoos. Zoos provide safety, food and space for the animals. Also the rare and endangered species are well preserved in zoos. Breeding is also done preventing the rare species from being extinct. Zoos also make people aware of the importance of animals by providing information and make people realise that animals are really assets of a state or country. So it would not be

proper to state that keeping animals in zoos is unethical, provided the animals are not being ill treated in zoos.

Niva Brahma
Guwahati, Assam

Denying the Right to Live

It is true that zoos are for conservation of biodiversity where animals are thought to be safe. But it is quite unethical. Because zoos contain much smaller areas and they can't provide the animals the free and natural lives that they have in forests. Zoos are nothing but artificial museums of animals and we claim that there we provide them a natural atmosphere and thus conserve them. But our claim is hundred percent false and it is surely unethical. By doing this we are denying the animals their right to live. Instead, we should develop the national parks and reserved forests in our country thereby giving the animals a fearless natural life under our guidance.

Dhritiman Kakati
Cotton College, Guwahati

Sanctuaries Better Than Zoos

Yes, I absolutely agree with the above proposition. Animals would be healthy in their natural surroundings joyfully playing and preying on their natural preys. Their numbers would get multiplied in their natural surroundings such as forests. They can be best kept in wild life sanctuaries like National Parks. For example, Kaziranga National Park and Jim Corbett National Park.

To confine them to a limited space like Zoos would be against ethics and against the general well being of

endangered species like tigers, some rare birds and reptiles. If we don't want them to be extinct and want to provide them with a healthy environment, wild life sanctuaries like national parks are better than Zoos. We don't want to be caged like wild animals in Zoos. Isn't it? The same rule applies to wild animals. It is highly unethical to cage or confine them in Zoos, which make the animals mentally and physically disturbed making them susceptible to several diseases and affecting their mating and breeding habits thereby diminishing their numbers leading to extinction. Due to destruction of their natural habitats by humans, recently some wild animals like panthers preyed on humans in Maharashtra's border villages including some suburbs of Mumbai.

Ms. Nirmala P. Rao
Hyderabad

Maintain the Zoos

Zoos are both necessary and unnecessary for many reasons. Zoos are necessary for protection and conservation of many species. Many species are



already extinct, some are on the way to becoming extinct. So, zoos can educate the public about the importance of wildlife. But zoos are not being kept properly, they are made to starve, they do not reproduce because they are not living in their natural habitats. So zoos should be well maintained.

Samarpita Pradhan
Keonjhar, Orissa

Now write in your thoughts on this topic for inclusion in the forthcoming issues:

"Sports should be made compulsory in schools."

Be brief and be logical! Send in your photo, if you like.

CHEMICAL TECHNOLOGY

BIBHUTI NARAYAN BISWAL

- What is the process of heating a substance to obtain the compound of low molecular weight called?
 - Vulcanization
 - Cracking
 - Esterification
 - Co-polymerization
- What is the process of conversion of solid directly into vapours without forming a liquid called?
 - Sublimation
 - Distillation
 - Calcination
 - Isolation
- The method employed to separate the mixture of two different liquids is:
 - Crystallization
 - Distillation
 - Filtration
 - Sedimentation
- Name the type of distillation used for separating liquids that decompose below their boiling point:
 - Dry distillation
 - Fractional distillation
 - Destructive distillation
 - Vacuum distillation
- The process in which a liquid can be separated from its solid residue is called:
 - Filtration
 - Distillation
 - Fractionation
 - Decantation
- The method that is used to separate a mixture of two liquids having difference in their boiling points is:
 - Filtration
 - Sublimation
 - Distillation
 - Cracking
- The technique of gravimetric analysis is meant for:
 - Determination of masses of the constituents in a compound
 - Determination of the type of a bonding in a compound
 - Determination of melting point & boiling point of a compound
 - Determination of volume of the constituents in a compound
- Haber's process is widely used in industries to manufacture:
 - Ammonia from nitrogen & hydrogen
 - Sulphuric acid
 - Sodium Bicarbonate
 - Chlorine
- Type of distillation that is employed to obtain coke from coal is:
 - Destructive distillation
 - Fractional distillation
 - Dry distillation
 - Vacuum distillation
- Many doctors use this technique to separate the red blood cells from blood:
 - Chromatography
 - Centrifugation
 - Distillation
 - Precipitation
- Ammonium chloride (NH_4Cl) and sodium chloride can be separated from each other by the process of:
 - Sublimation
 - Decomposition
 - Evaporation
 - Gravity separation
- Wine industries & sugar industries use the method of fermentation. It was discovered by:
 - Alexander Fleming
 - Louis Pasteur
 - Edward Jenner
 - Roentgen
- The commonly used antacid $\text{Mg}(\text{OH})_2$ works on the principle of:
 - Neutralization
 - Dehydration
 - Dilution
 - Acidification
- Petroleum is refined in oil refineries by using.....process?
 - Fractional distillation
 - Fractionation
 - Dry distillation
 - Vacuum distillation
- Muddy water can be purified by using alum that uses the process of:
 - Dialysis
 - Precipitation
 - Coagulation
 - Adsorption
- The method of electroplating is used widely in industries to:
 - Coat superior metal over inferior metal
 - Protect metal from rusting
 - Protect metals from corrosion
 - All of these
- The method in which metal is isolated by adding ore to a chemical reagent followed by precipitation of the metal by a more electropositive metal is called:
 - Zone refining
 - Electro refining
 - Electrometallurgy
 - Hydrometallurgy
- The method of annealing is familiar in steel industries. It refers to:
 - Heating the rods of iron & embedding them in charcoal
 - Heating steel followed by its slow cooling
 - Heating steel to red hot followed by its slow cooling
 - Heating steel to red hot followed by its sudden cooling
- The cupellation method is widely used for the extraction of metals such as:
 - Aluminium
 - Oxygen
 - Silver
 - Sodium
- The method of saponification is used for the manufacture of soaps in soap & detergent industries. It involves:
 - Hydrolysis of fats and oils with alkalies
 - Hydrolysis of esters with alkalies
 - Reaction of ethanol with acetic acid
 - None of these

ANSWERS:

- | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|
| 1. b | 2. a | 3. b | 4. d | 5. d | 6. c | 7. a |
| 8. a | 9. a | 10. b | 11. a | 12. b | 13. a | 14. a |
| 15. c | 16. d | 17. d | 18. c | 19. c | 20. a | |

Contributed by Shri Bibhuti Narayan Biswal, Principal, Sri Sathya Sai Vidya Niketan, Ganesh Vad Sisodra, near Tata SSL, N.H.-8, Navsari-396463, Gujarat

CARBOHYDRATES

JAYANTA SONOWAL

- The simplest carbohydrate of the following is:
 - Glucose
 - Sucrose
 - Cellulose
 - Lactose
- Abundantly found carbohydrate unit in the semen is:
 - Maltose
 - Fructose
 - Glycogen
 - Heptulose
- Which one of the following is an example of a glycoside antibiotic used in tuberculosis?
 - Penicillin
 - Streptomycin
 - Tetracycline
 - Cyclohexamide
- Which of the following one is found in milk?
 - Sorbitol
 - Lactose
 - Mannose
 - Arabinose
- Which of the following monosaccharide unit is found in RNA?
 - D-ribose
 - D-deoxyribose
 - D-ribulose
 - D-xylose
- Which one of the following is not a gluconeogenesis enzyme?
 - Glucose 6- phosphatase
 - Fructose 1, 6-bisphosphatase
 - Phosphoenolpyruvate carboxykinase
 - Pyruvate dehydrogenase
- Which one of the following enzyme is not involved in conversion of pyruvate to acetyl CoA?
 - β -galactoside transacetylase
 - Dihydrolipoyl dehydrogenase
 - Pyruvate dehydrogenase
 - Dihydrolipoyl transacetylase
- Which one of the following substrate is precursor of normal gluconeogenesis?
 - Glucose
 - Triacylglycerol
 - Pyruvate
 - Glycine
- Which one of the following is non-oxidative phosphorylated product?
 - Succinyl CoA
 - α -ketoglutarate
 - Succinate
 - Oxaloacetate
- Which one of the following enzyme is involved in reversible reaction of glycolysis?
 - Hexokinase
 - Enolase
 - Pyruvate kinase
 - Phosphofructokinase
- The synthesis of glucose in liver from lactate of skeletal muscle is known as:
 - Futile cycle
 - Cori cycle
 - TCA cycle
 - Glyoxylate cycle
- Which one of the following does not happen in cytosol?
 - Glycogenesis
 - Gluconeogenesis
 - HMP-shunt
 - TCA cycle
- The end product of citric acid cycle is:
 - CO_2 and H_2O
 - Acetyl CoA and CO_2
 - Oxaloacetate and H_2O
 - Succinate and CO_2
- Enlarged liver and kidney is a disease cause due to deficiency of enzyme glucose 6-phosphatase. The name of the disease is:
 - Pompe's disease
 - Cori's disease
 - Von-gierke's disease
 - Anderson's disease
- Due to defect of enzyme gulonolactone oxidase the human body can't synthesize a vitamin called:
 - Vitamin C
 - Vitamin K
 - Vitamin A
 - Vitamin D
- Which one of the following is not an amino sugar?
 - Sialic acid
 - Galactosamine
 - Mannosamine
 - Acetic acid
- Complete oxidation of one glucose molecule yields:
 - 38 ATP
 - 30 ATP
 - 12 ATP
 - 24 ATP
- The connecting link between hexose monophosphate shunt and lipid synthesis is:
 - Ribose
 - NADPH
 - Seudoheptulose 7-phosphate
 - NADH
- The hormone that lowers the cAMP concentration in liver cell is:
 - Glucagon
 - Insulin
 - Epinephrine
 - Thyroxine
- Galactosemia is a disease caused due to lack of an enzyme that is involved in galactose metabolism. The name of the enzyme is:
 - Hexokinase
 - Glucokinase
 - Galactokinase
 - Phosphofructokinase
- Fructokinase is an enzyme involved in fructose metabolism. The disease caused due to the lack of this enzyme is:
 - Fructosuria
 - Fructose intolerance
 - Bone deformities
 - Incomplete digestion
- Metabolism of alcohol in animal cells depend upon the capacity of:
 - Liver muscle
 - Hepatocytes
 - Skeletal muscle
 - Erythrocytes
- Glycogen is a storage food of animal. Which one of the following contains glycogen of non-animal origin:
 - Algae
 - Fungi
 - Mycoplasma
 - Mangrove plant
- The condensed form of glucose and fructose is:
 - Galactose
 - Mannose
 - Sucrose
 - Lactose
- For normal function, the amount of carbohydrate required by the human brain per day is:
 - 200 gm
 - 120 gm
 - 160 gm
 - 180 gm

ANSWERS:

- | | | | | | | |
|-------|-------|-------|-------|-------|-------|-------|
| 1. a | 2. b | 3. b | 4. b | 5. a | 6. d | 7. a |
| 8. c | 9. c | 10. b | 11. b | 12. d | 13. a | 14. c |
| 15. a | 16. d | 17. a | 18. b | 19. b | 20. c | 21. a |
| 22. b | 23. b | 24. c | 25. b | | | |

Contributed by Shri Jayanta Sonowal (JRF), DST, Phytodiversity Research Cell, Department of Botany, Darrang College, Tezpur-784001, Assam

How often have you had an Aha! Moment – when the solution to a problem has suddenly emerged after hours of labouring over it? Read more about it.

Aha! Moments

ONE hot afternoon at home, I was making an Origami (paper folding) frog. Origami books describe complex 3D folds with 2D drawings. However good the illustrations and descriptions maybe, some folds end up being very hard to understand. That afternoon I was stuck on one such difficult fold. After a long struggle trying out different folds, I was about to give up and close the book, when I had this sudden moment of revelation and I knew how to make the fold. Until this day I have no idea how I arrived at the solution. The answer suddenly 'clicked' to me and the frog was done.

Years later when I had a discussion with my professor of Neuro-engineering, I understood that what I had experienced was an 'Aha!' moment. Mine wasn't a groundbreaking discovery. Nevertheless it was similar

to the Aha! moment experienced by Archimedes, who ran out of his bath tub shouting 'Eureka!' (I found it). Many a famous discoveries are attributed to Aha! Moments—Newton's discovery of the gravitational force, Charles Darwin's discovery of evolution and Kekule's Benzene ring.

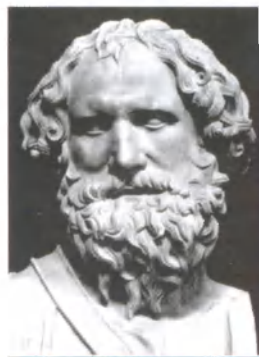
Now, there are some unique characteristics of an Aha! moment: 1. The solution is sudden, 2. We are never aware of the steps through which the solution occurred to us, 3. The solution usually occurs after a period of fruitless struggle and 4. Not to forget the strong emotional Aha! or Wow! or Oh! feeling that accompanies any Aha! moment.

The following fact makes Aha! moments more special: According to Donald O. Hebb, a prominent neuroscientist, Aha! moments are the predominant mode of adult learning. 'Learning' is an unsolved mystery for neuroscientists. That's right, the great gift that we humans possess, the ability to 'learn' is still not completely understood. Understanding Aha!

moments would be a small step towards understanding learning. Not only learning, the greatest wonder of science is that, having explored from quarks to quasars, we have not explored much into our 'exploring instrument', our brain.

Why did Donald Hebb consider Aha! moments the 'most' important form of adult learning? Because a linear learning curve is not sufficient to obtain the kind of vast knowledge we possess, jumps and leaps are certainly necessary. So Aha! moments are not the unique property of scientists but a common occurrence even to the common man.

Aha! moments have been the subject of the neuroscientist's curiosity always. Until now Aha! moments were studied during puzzle solving, wherein the occurrence is frequent. But Aha! moments occur during day-to-day activities also. At University of Houston, we took up a new method that employs visual images to elicit Aha! moments.



Archimedes, had a 'Eureka!' moment

What studies show is that, the more 'focused' attention you pay, less the chances of an Aha! moment.

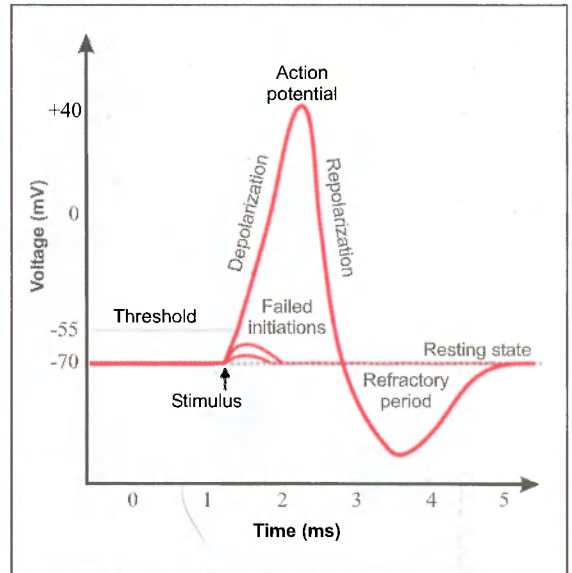
For an Aha! moment to occur a proper problem space has to be formed in the brain, the constraints of the problem should lead to a fruitless struggle and only then, all of a sudden the answer might suddenly click.

A two-tone image used in the study, after focused viewing the object suddenly 'pops-out' to the viewer.



A single action potential plotted from an intracellular recording from a neuron. Note the time span and amplitude of the action potential. (right)

The great gift that we humans possess, the ability to 'learn' is still not completely understood.



A black and white image with no gray shades looks like a collection of splotches; only after a period of focused viewing the object in the image suddenly 'pops-out' to the viewer. The moment when the object in the image 'pops-out' to the viewer is the Aha! moment. That is, without integrating the splotches part by part and finding the solution, all of a sudden, a hitherto nonsensical image becomes meaningful.

For the study, we make our test subjects (people taking our test) look at our test images (we made 300 black and white images of common objects). While they try to decipher the objects in the images, we record their 'brain waves', the electroencephalogram or EEG.

Before going any further, the EEG must be explained. The brain is made of millions of nerve cells called 'neurons'. Neurons talk to each other. Their language is in the form of electrical and chemical signals. The electrical signals are called 'action

potentials'. Action potentials are generated inside each neuron and this action potential triggers the release of neurotransmitters (chemical) from that neuron, which forms the chemical signal. The generation of action potentials by a neuron is informally called 'firing'. The chemicals released from one neuron, when received by neighboring neurons trigger an action potential in them.

The bewildering aspect is that all action potentials are always the same. An action potential is always 40 microvolt high and a few millisecond long. Pick any neuron in any region of the nervous system and the action potential you will plot will be identical to that from any other neuron. So our neurons speak in a single alphabet language! How can a single alphabet code lead to all the complexities of our brain? Our dreams, imaginations, mathematics, language, art, and simple activities like movements, speaking, eating and

breathing are all the result of this single alphabet code!

Although the study of action potentials and the brain language is tempting, it is not always possible to study the brain using action potentials, because we will have to cut open the skull and place sensors on the live brain without damaging it. So what most studies do is listen to the neurons from the outside. Even the simplest job lifting a finger or even deciding to lift a finger requires the functioning of thousands of neurons. The combined activity of neurons can be measured as tiny electrical signals on the scalp. We place sensors called electrodes on the scalp. These sensors have very powerful amplifiers.

The analog signals from the sensors are digitized and stored in a computer. Any activity that can lead to firing of neurons is called a stimulus. Stimuli can be external or internal. A sound tone, a visual image, a touch or smell are external stimuli. Some examples of internal stimuli are the thought that makes you lift a finger or rub your nose. But apart from the response to stimuli, the brain has a constant background rhythm called the 'spontaneous' EEG. All responses to stimuli are believed to be superimposed on the spontaneous rhythm.

During the recording of the EEG there is a lot of noise addition. Head movements, eye movements and blinks, swallowing and talking also lead to electrical signals generated by the muscle cells. These signals called



EEG Recording



EEG provides very good temporal resolution but not good spatial resolution.

the Electromyograph also get recorded along with the EEG. Any analysis using EEG should first clean the EEG signals from the electromyographs, and separate the responses to stimuli from the spontaneous rhythms.

One special aspect of EEG is its sensitivity in time. EEG can capture brain activity almost as soon as it occurs, that is within a few milliseconds, which is quick enough to study the brain. This is not the case with other brain imaging techniques like the MRI or PET scans which can measure responses only a few minutes after they occur. But the problem with EEG is that, it is the sum of activity that happens within the skull, so it is hard to tell if the activity measured in any one sensor is purely due to the activity of the brain directly below it. In technical terms,

EEG provides very good temporal resolution but not good spatial resolution.

Going back to the Aha! moment study, we record the EEG of our subjects while they stare at the black and white images and struggle to identify the object in it. The EEG during which the subjects stare at the image fruitlessly would be compared to the EEG when they have an Aha! This would tell us what happens in the brain when someone has an Aha! moment.

One more thing to know about the brain is that, there are specific areas in the brain that perform specific functions.

The brain lobes

For example, the occipital lobe (the portion right above your neck on the

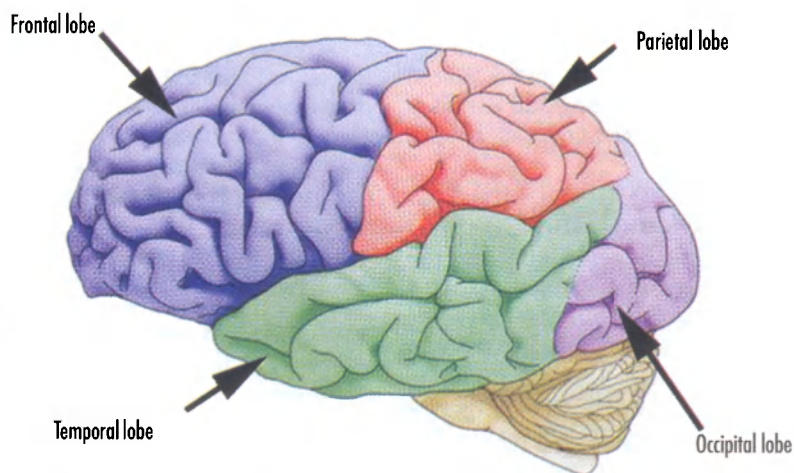
posterior side), is responsible for low level visual processing; it is called the visual cortex. The portion right behind and above your ears processes auditory data, it is called the auditory cortex. The parietal cortex (the area between the occipital cortex and your ears) and the frontal cortex (the area behind your forehead) are together responsible for attention. Attention in neuroscience is compared to a spotlight.

Every instant, any region of the brain is flooded with information from the senses, the internal organs and even other regions of the brain. Either consciously or not, it is not possible for us to pay attention to each and every bit of information. The only possibility is that the brain ignores what it thinks as 'unnecessary' and throws light on what it considers important; this is the 'attentional spot-light'.

Now, the parieto-frontal network (that is the parietal and frontal lobes together) is known for focused attention processing. What studies show is that, the more 'focused' attention you pay, less the chances of an Aha! moment. Lesser-focused attention (attention to parts) should lead to processing of the problem as a whole and thus lead to an Aha! moment. In relation to our study this would suggest that if the image is processed as a whole (either consciously or unconsciously), instead of looking at individual splotches and trying to integrate them, there are greater chances of an Aha! moment.

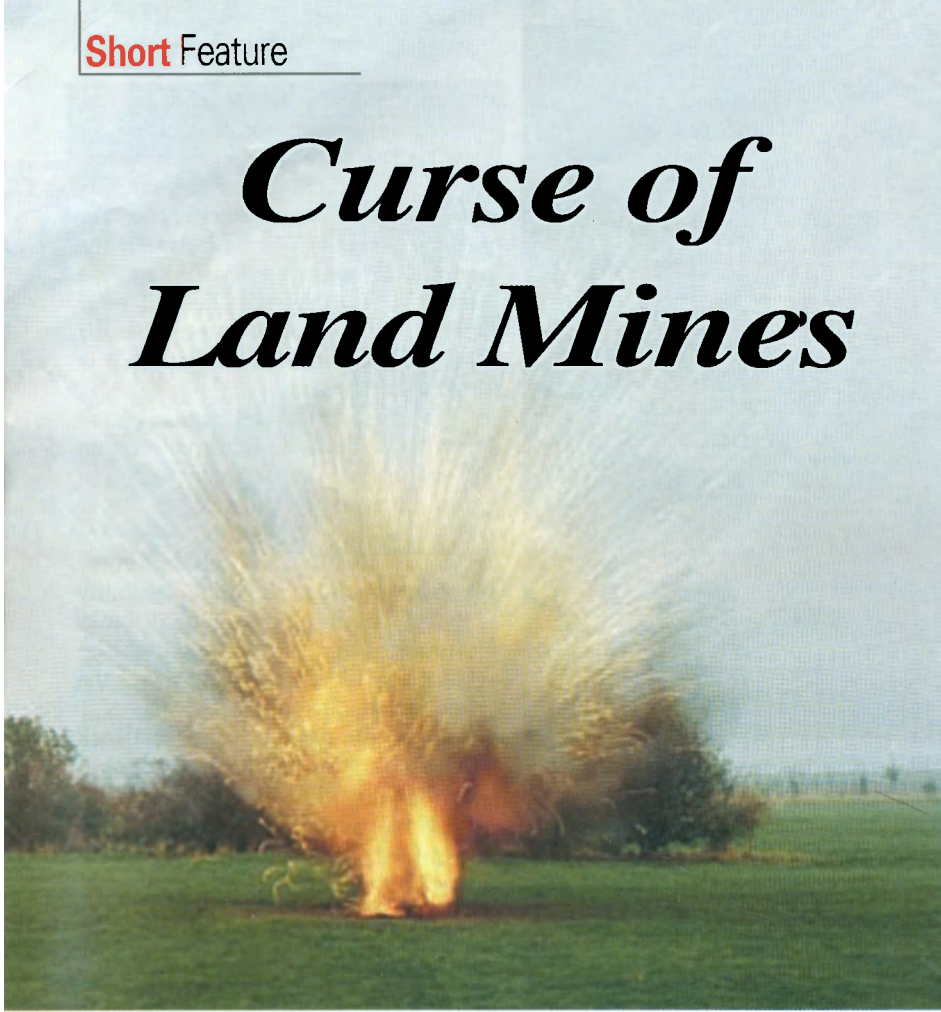
We have proof from studies that Aha! moments do lead to jumps in the learning curve. Donald Hebb's theory that Aha! moments are an important mode of adult learning implies that we have to rethink our teaching methodology. For an Aha! moment to occur a proper problem space has to be formed in the brain, the constraints of the problem should lead to a fruitless struggle and only then, all of a sudden the answer *might* suddenly click.

If things take a good turn, its good news for kids and students, no more mugging up textbooks and no more finger crunching exams, education will be challenging with problem solving and Aha! moments.



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Curse of Land Mines



ALMOST 40 people were killed recently when a land mine blast perpetrated by Maoist rebels blew up a civilian bus in the Dantewada district of the state of Chattisgarh. Innumerable unsuspecting lives are lost every year to such land mine blasts. Children, curious by nature, are the most at risk.

According to a report by the United Nations, children in at least 68

countries are today threatened by mines planted on the land they live on. Over 110 million land-mines of various types — plus millions more unexploded bombs, shells and grenades — remain hidden around the world, waiting to be triggered by the innocent and unsuspecting, the report says. So common are mines in Cambodia that they are now used for fishing, to protect private property and even to settle private disputes.

Once laid, a mine may remain active for up to 50 years. Unless vigorous action is taken, mines placed today will still be killing and maiming people well into the middle of the next century.

What is a Land Mine?

A land mine is a target-triggered explosive weapon; the target may be a person or vehicle. Surprisingly, this device was not invented in this century. Since ancient times their non-explosive predecessors like caltrops, stakes and spikes have been used on the battlefield.

Forces in ancient Rome sometimes dug small foot-sized holes, covered and armed with a sharpened spike. In the Middle Ages in Europe, small, four-pronged spiked devices called caltrops or crows' feet could be scattered on the ground to delay the advance of an enemy, but these devices were not explosive. Today, however, land mines could be called silent explosives.

Land mines are designed to deter, channel, delay or kill an enemy. These are basically force multipliers that increase the efficiency and defending force without requiring more personnel in the operation in which they are involved. As the name itself indicates, their origin lies in the practice of mining, where to defeat an enemy a tunnel is dug and over there are placed explosives, the trigger of these explosives is placed somewhere in the path of the target.

A land mine has the following main components:

- Firing device that initiates (activates) the mines,
- Detonator or igniter that sets off the booster charge,
- Booster charge that may be attached to the fuse, or the igniter, or be part of the main charge,
- Main charge that is kept in a container and which usually forms the body of the mine, and
- Casing that covers the device.

How is it Triggered?

A land mine can be triggered by a number of things that include pressure of the target, movement of the target after application of pressure, vibration caused due to sound produced by the target, and attracting force of the target or magnetism. Mines commonly in use employ the pressure of a person's foot as a trigger, but tripwires are frequently employed, as they are easy to make and set up.

Most modern anti-vehicle mines use a special type of magnetic trigger that detonates even if the tyres or tracks do not touch it. Today, even advanced mines are in use that are able to sense the difference between friendly and enemy vehicles by way of a built-in signature catalog. This enables all the





friendly forces to use the mined area while at the same time prohibiting enemy access to the area.

Most mines, with few exceptions, combine the main trigger with a touch or tilt trigger to make the work of enemy engineers who try to defuse it all the more difficult. Mines are designed in such a way that they use the least amount of metal to make searching with a metal detector much more difficult. Use of plastics has added advantage of being very inexpensive.

Since it is difficult to remove mines, some countries including United States have designed mines that have the ability to self-destruct, or chemically render themselves inert after a period of weeks or months to reduce the likelihood of civilian casualties at the conflict end. However, these self-destruct mechanisms are not absolutely reliable, and most land



mines laid historically are not equipped in this manner. Self destruct mechanisms depend upon the weakening of the charge that triggers them—the battery or the charge kept in it withers away after a period of time.

Special types of mine, commonly called anti-tank mines, have a peculiar feature—they destroy only heavy targets such as trucks, tanks, buses because they have high pressure sensing capacity that works only for weights greater than 100 kg. The mine gets activated only when a heavy weight passes over it.

How are Mines Laid?

Laying of mines can be done by several means but the most preferred way of placing of mines at the executing spot is by taking help of specially trained engineers. This is the most laborious of all techniques used in the installation of the device and is also very reliable as well as economic. Another way of laying mines is through mine-laying vehicles, which are specially meant for the purpose. With the help of artillery mine-scattering shells can also be fired from a few kilometers. Mines can also be ejected from cluster bombs or cruise missiles or can be dropped down from helicopters or airplanes.

Laying of mines is quite easier and inexpensive in comparison to its removal. Since the mines have non-metallic body and are of relatively small size, this makes the process of demining expensive, time consuming and dangerous. Trained engineers, with special equipment, are required for the purpose. Nowadays hybrid

Most modern anti-vehicle mines use a special type of magnetic trigger that detonates even if the tyres or tracks do not touch it.

techniques like dogs and rats are involved in the process of demining because of their specially trained sensing capability to detect metals and explosive. It has been estimated that laying of mines and defusing them costs in the ratio of 1:1000 (i.e. if 1 dollar is spent on the manufacturing then 1000 dollar is spent on defusing it).

A Lethal Threat

Much after the war has ended, land mines and unexploded bombs continue to pose a lethal threat to human life and claim casualties. According to estimates, every 30 minutes, someone, somewhere in the world is injured or killed by an encounter with this deadly debris, and at least one in every four victims is a child.

Mines remain dangerous after the conflict in which they were deployed, killing and injuring civilians and rendering land impassable and unusable for decades. Their deadly nature has led several countries to promote efforts to ban land mines.

One such effort is the Ottawa Treaty. It is a convention for the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and their Destruction. It came into force on 1 March 1999. The treaty was the result of the leadership of the Government of Canada working with the International Campaign to Ban Land mines, launched in 1992. The campaign and its leader, Jody Williams, won the Nobel Peace Prize in 1997 for the efforts. As of 2007, a total of 158 nations have agreed to the treaty. Thirty-seven countries have not agreed to the ban, which includes countries like China, India, Israel, Pakistan, Russia and the United States.

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■ In the last 25 years, more than 50 nations have mined more than 2 crore land mines.

■ 15 to 20 thousands innocents lose their life every year to mines.

■ Land mines also retard the growth of plants, as they destroy the geographical layer of the earth.

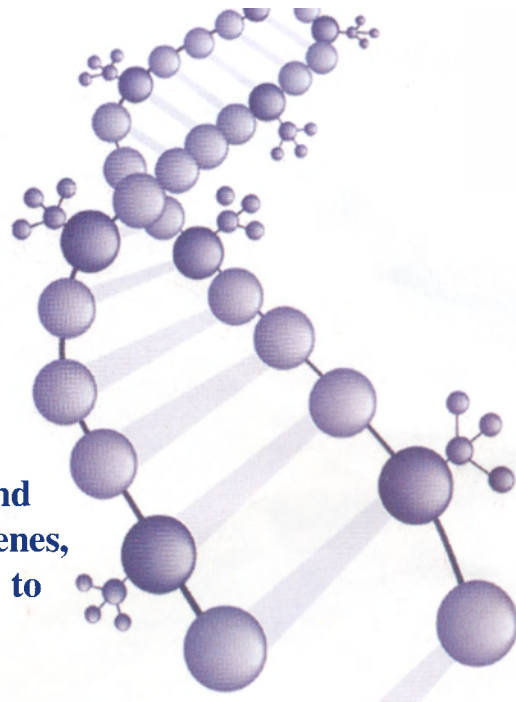
■ According to UNICEF, nearly 30-40% of the total victims are children or youths.

■ It costs approximately 3 dollar to manufacture a land mine, while their removal costs 1000 dollars.

Epigenetics: New Buzzword in Biotechnology

Many environmental factors like diet, stress and prenatal nutrition can make an imprint on our genes, which can then get passed from one generation to the next through these epigenetic marks.

ARVIND MISHRA



DARWIN taught us that evolutionary changes manifest themselves after many generations that may even involve millions of years of natural selection in any population. But according to a new science called “epigenetics”, environmental conditions could also leave an imprint on the genetic material in eggs and sperm, short-circuiting the evolutionary process and passing along new traits observed even in a single generation.

Epigenetics examines the inheritance of characteristics that are not set out in the DNA sequence. A renowned science writer and the author of the book, *The Genius in All of Us: Why Everything You Have Been Told About Genetics, Talent and*

IQ Is Wrong, David Shenk, calls “epigenetics the most important discovery in the science of heredity since the gene.” The journal *Science* too published a special issue on Epigenetics as early as in 2001.

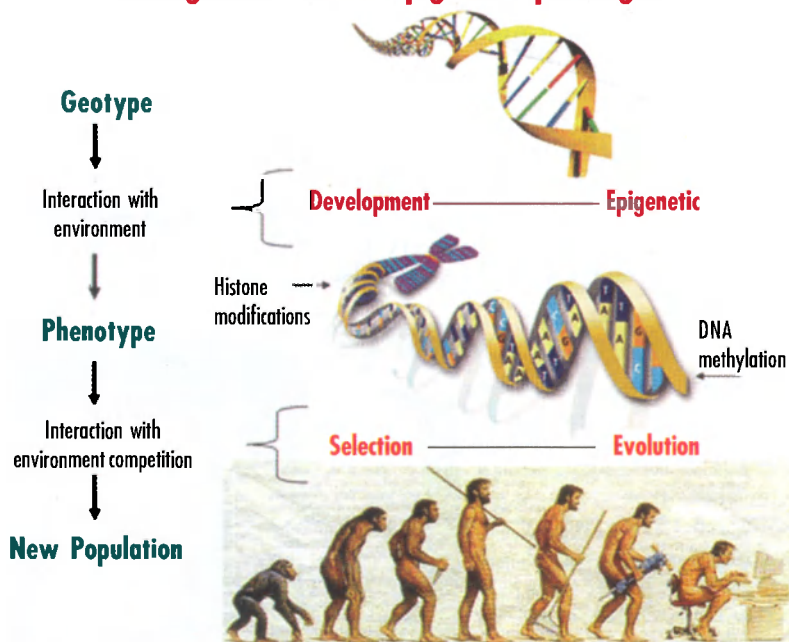
New Branch of Knowledge!

According to recent studies by scientists like Dr. Lars Olov Bygren, a preventive-health specialist of Karolinska Institute, Stockholm, Epigenetics has opened new vistas to the understanding of heredity and genetic science. Contrary to conventional genetics, it is in fact the study of changes in gene activity that do not envisage alterations in the genetic code but still get passed down to at least one successive generation. Gene expressions in such cases are interestingly governed by the cellular material — the epigenome — that is positioned on top of the genome, just outside it (hence the prefix *epi-*, which means above).

The presence of certain epigenetic ‘marks’ in the said epigenome induces genes to switch on or off, or, in other words, speak loudly or **whisper**. Many environmental factors like diet, stress and prenatal nutrition can make an imprint on genes, which can then get passed from one generation to the next through these epigenetic marks.

There is now evidence that certain lifestyle habits like smoking and eating too much can alter the epigenetic marks situated on the top of your DNA in ways that could activate the genes for obesity to express too strongly and the genes for longevity to express too weakly. It is now clear that certain bad habits like these can also predispose your kids — before they are even conceived — to certain diseases and even premature death.

The genetic versus epigenetic paradigm



Resurgence of Lamarckism?

Some geneticists quietly acknowledge the emergence of epigenetics as the resurgence of Lamarckism, which Darwinists have long disparaged. Jean-Baptiste Lamarck (1744-1829) argued that evolution could occur within a generation or two. He explained that animals acquired certain traits during their lifetimes because of their environment and choices. The oft repeated example of Lamarckism is of giraffes which are stated to have acquired, according to Lamarck, their long necks as their recent ancestors used to stretch their necks to reach high, nutrient-rich leaves.

Darwin however argued that evolution works not through any such effort but through a mechanism called natural selection. Accordingly, giraffes got their long necks over millennia because genes for long necks had, very slowly, gained advantage and were selected to go ahead with evolutionary process. But epigenetics it seems is now attracting the attention of scientists to re-evaluate Lamarck's outdated (?) ideas.



Smoking too much could activate the genes for obesity to express too strongly and the genes for longevity to express too weakly.

But here is good news as well. Researchers are now able to manipulate epigenetic marks in the laboratory and are also engaged in developing drugs that treat illness simply by silencing bad genes. The Food and Drug Administration (FDA) approved an epigenetic drug in 2004 – Azacitidine – which is used to treat patients with myelodysplastic syndromes (MDS), a group of rare and deadly blood malignancies. Azacitidine acts on epigenetic marks to dampen down genes in blood precursor cells that have become over expressed. The FDA has approved three other epigenetic drugs including one that may act on tumor-suppressor genes. Ongoing epigenetic research may pave the way towards controlling genes that play a role in many diseases including cancer, schizophrenia, autism, Alzheimer's, diabetes and many others and to induce them to remain dormant.

Our lifestyle and environment can change the way our genes are expressed. Genetic researchers have lately begun to realize that epigenetic studies might also help explain certain health related age-old mysteries like the one about twins. It has been observed that one member of a pair of identical twins could develop asthma even though the other remains fine throughout life. Likewise, autism affects boys four times as often as girls. In such cases, the genes may be the same, but their patterns of expression might have been influenced by epigenetic factors. Further studies are in progress to examine specific mechanisms that cause this so-called epigenetic drift in identical twins.

Mechanism Involved

The mechanism of at least one of the many equations involved in epigenetics is quite simple. One carbon atom attached to three hydrogen atoms, called a methyl group, is a basic unit in organic chemistry: DNA methylation is a process in which a methyl group attaches to a specific spot on a gene and is capable of changing that gene's expression and switching it off or on – suppressing it or making it pronounced.

A Duke University oncologist Randy Jirtle and one of his postdoctoral students, Robert Waterland, conducted an

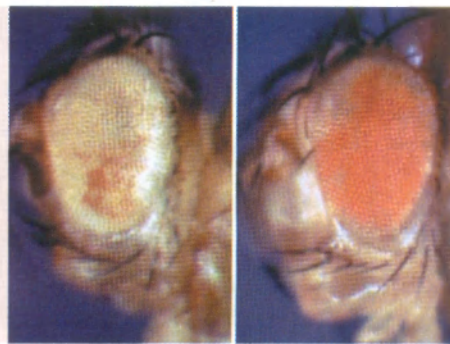
exemplary experiment on mice in 2003 with a gene that gives mice yellow coats and a propensity for obesity and diabetes when expressed continuously. Jirtle's team fed one group of pregnant mice a diet rich in B vitamins (folic acid and vitamin B12). Another group of genetically identical pregnant mice got no such prenatal nutrition. The B vitamins acted as methyl donors: they caused methyl groups to attach more frequently to the targeted gene *in utero*, thereby altering its expression. Simply by furnishing B vitamins Jirtle and Waterland got experimental mothers to produce healthy brown pups that were of normal weight and not prone to diabetes even without altering the genomic structure of mouse DNA.

Many other recent studies have also depicted the power of environment over gene expression. Fruit flies when exposed to a drug called geldanamycin showed unusual outgrowths of their eyes—a trait that continued up to at least 13 generations of offspring without any alteration in DNA structure. Eva Jablonka and Gal Raz of Tel Aviv University have recently compiled some 100 forms of epigenetic inheritance (*Quarterly Review of Biology*, 2009).

Fruit Fly Eyes & Epigenetics

In an experiment conducted on a laboratory strain of the white-eyed fruit fly *Drosophila melanogaster* some very startling results were obtained. If the surrounding temperature, 25 degrees Celsius around the embryos of this

The two pictures show the eyes of two genetically identical flies. The difference in eye colour is determined by epigenetic factors. (Credit: Renato Paro/ETH Zürich)



Contradiction to Darwin's Theory of Evolution?

Not Really!

According to Darwin's theory, evolution is the result of the population and not the single individual. Environmental factors, which change the characteristics of an individual and are then passed on to its offspring, do not really fit into the theory of evolution. "Passing on the gained characteristics fits more with Lamarck's theory of evolution," says Renato Paro, a Swiss professor of Biosystems studies. But he still does not believe Darwin's theory of evolution is put into question by the evidence of epigenetics research. "Darwin was 100 percent right," Paro emphasises. For him, epigenetics complements Darwin's theory. In his view, new characteristics are generated and passed on via epigenetics, subject to the same mechanisms of evolution as those with a purely genetic origin.

The presence of certain epigenetic 'marks' in the said epigenome induces genes to switch on or off, or, in other words, speak loudly or whisper.

fruit fly, is briefly raised to 37 degrees Celsius, the flies hatch with red eyes. And if they are again crossed, the following generations are amazingly partly red-eyed – without further temperature treatment – even though only white-eyed flies are expected according to the rules of genetics.

Researchers in a group led by Renato Paro, professor for Biosystems at the Department of Biosystems Science and Engineering (D-BSSE), Switzerland, even crossed the flies for six generations and obtained the same results. Thus, they were able to prove that the temperature treatment changes the eye colour of this specific strain of fly, and that the treated individual flies pass on the change to their offspring over several generations. However, the DNA sequence for the gene responsible for eye colour was shown to remain the same for white-eyed parents and red-eyed offspring.

Epigenetic Changes: Permanent or Hereditary?

One could argue whether epigenetic changes might also become permanent? Yes, but it must be remembered that epigenetics is not evolution in itself – simply because it does not in any way alter the genetic material. Epigenetic manifestations just represent the biological response to environmental stressors in question. Although the very response can be inherited through many generations via epigenetic marks, if the environmental stressors are removed, the epigenetic marks will eventually fade, and the DNA code will begin to revert to its original status over time.

According to a recent study published in the *European Journal of Human Genetics*, the sons of men who habitually smoked in pre-puberty were found to be at higher risk for obesity and other health problems in their adulthood. It was hypothesized that there was a probability that these boys would also have shorter life spans. So, epigenetics warns you that a wrong decision taken by you as early as in childhood, like starting smoking at the age of 10, could be a double mistake of the medical and genetic kind.

Histones—Important Factors

It has now been concluded that the important factors are nucleoproteins called histones, a kind of packaging material for the DNA, which take active part in the said epigenetic manifestations depending on the chemical group they carry, whether they are acetylated or methylated, or whether they permanently activate or deactivate genes. Modern genetic tools and methods now allow researchers to sometimes even directly show which genes have been activated or deactivated by the histones.

Epigenetic marks, such as the modifications of the histones, are also important for the specialization of the body's cells as they are preserved during cell division and are passed on to the daughter cells. However, it is still unclear how the epigenetic markers are passed on to the daughter cells. During cell division, the DNA is doubled, which requires the histones to break apart. The unresolved question is therefore how cellular memory encoded by epigenetic mechanisms survives cell division.

Emerging Areas

The current focus of research is on the mechanism of inheritance of epigenetic characteristics from parents to the offspring. Researchers now know that when gametes are formed, certain epigenetic markers are passed on to the offspring. How much and which part of the epigenetic information is preserved and subsequently inherited are questions that are currently being researched.

The focus is also to look at the influence of various substances from the environment on the epigenetic constitution of organisms, including humans. Diet and epigenetics appear to be closely linked. The most well known example is that of Agouti mice which if fed with a cocktail of vitamin B12, folic acid and cholin, directly prior to and during pregnancy, give birth to mainly brown, slim and healthy offspring.

Central Issue in Biology

The National Institutes of Health (NIH), a part of the U.S. Department of Health and Human Services, announced in 2008 their plans to spend \$190 million on developing a multi-lab, nationwide initiative to understand processes involved in epigenetics. Epigenetics has become "a central issue in biology," said Dr. Elias Zerhouni, director of NIH while awarding the grant.

It is reported that the NIH has also prepared "the first detailed map of the human epigenome." Though the claim appears a bit exaggerated, it also reminds us of the success of the Human Genome Project that was completed in March 2000 costing \$3 billion to map all the human genes. Although mapping a human epigenome looks a huge task, it could also see the light of the day quite soon with rapid developments going on in computing power.

It is being said that when completed, the Human Epigenome Project (which is already under way in Europe) will make the Human Genome Project look like child's work.

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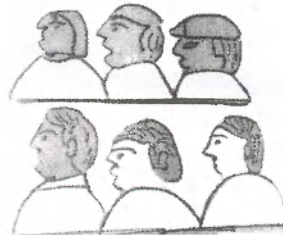
CARTOONS by
DR K K AMBASTA

West of Orient Club, Krishan Lal Lane-3, Amgola,
Muzaffarpur, Bihar

HUMAN EVOLUTION
Man and chimpanzee
having 98% similar DNA



*So I deserve at least 98%
Human Right Protection
but ...*



*You people are bigger fools
as you are cutting the
forest on which you depend*

*See, the fool, he is
cutting the branch on
which he is sitting*



Childhood cancers can occur suddenly, without early symptoms, but fortunately have a high rate of cure.

THE Sharmas were a happy couple till a few weeks back. But events of the last few days turned their life upside down. Mayur, their six-year-old son was diagnosed with acute lymphoblastic leukemia, in other words, blood cancer. The family was shattered.

However, Dr Joshi, the chief oncologist, patiently explained to the Sharma family that nowadays cancer does not mean inevitable death. Advances in medical sciences have made the cure possible in many cases. What is more important is not to lose hope and fight this disease at all levels.

Although it is painful to see children, who should be playing at their age, being confined to cancer wards, it is true that just as adults children too can get cancer. Childhood cancers can occur suddenly, without early symptoms, but fortunately have a high rate of cure.

The World Health Organization (WHO) has reported that 500,000 of the estimated 2.5 million cancer patients in India are children. Though children can get cancer in the same parts of the body as adults, some types of cancer are more common in children. The most common form of childhood cancer is leukemia, which develops in the bone marrow. Other cancers often found in children are brain tumors, childhood lymphomas, Hodgkin's disease, Wilms' tumor, neuroblastomas, osteogenic sarcomas, Ewing's sarcomas, retino-blastomas, rhabdomyosarcomas and hepatoblastomas. As children enter their teen years, there is also an increase in the incidence of osteosarcoma (bone cancer).

In India, the reported incidence of childhood cancer has increased over the last 25 years, but the increase is

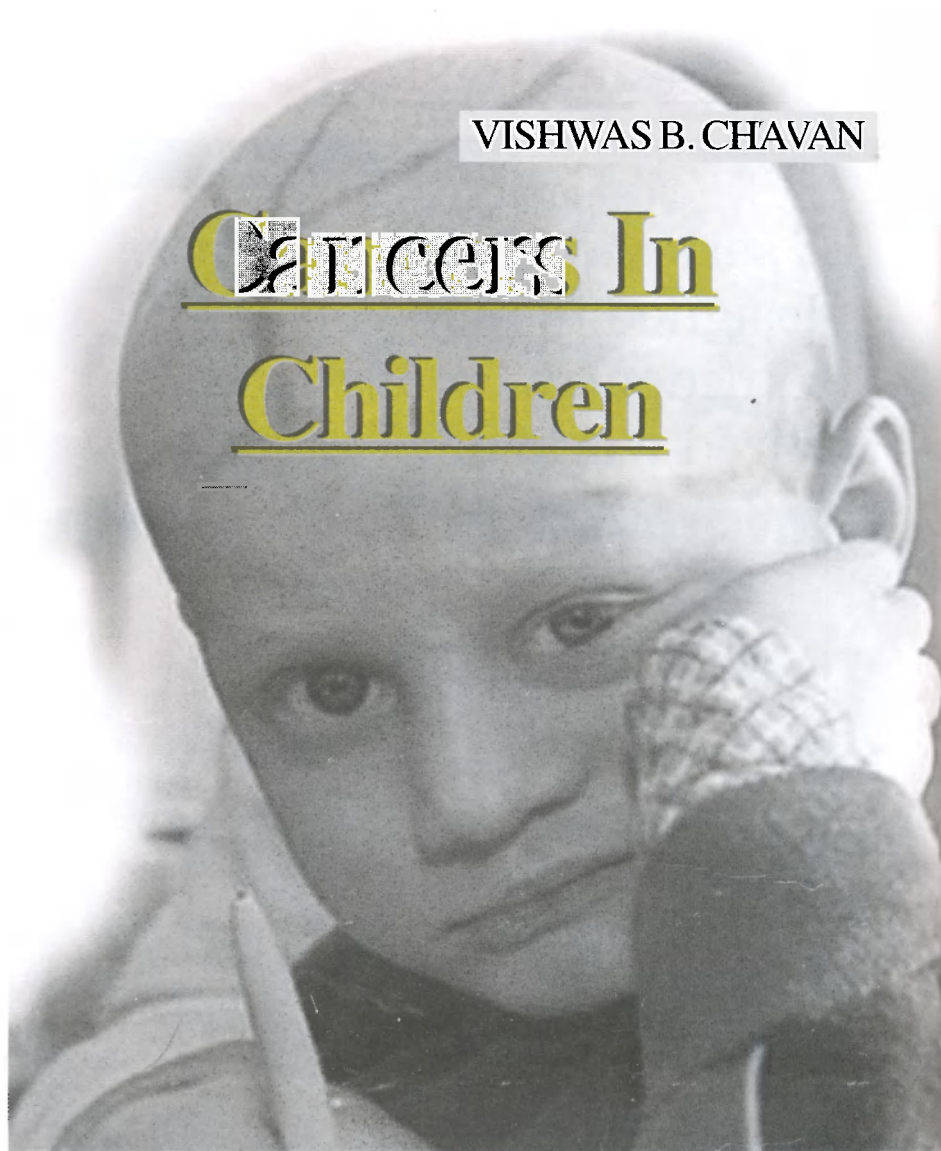
much larger in females than males. (Arora RS, Eden T, Kapoor G. "Epidemiology of childhood cancer in India." *Indian J Cancer*, 2009; 46:264-273)

Leukemia: Leukemias (cancer of the blood cells) are the most common childhood cancers (about 33% of all childhood cancers). Leukemia can be acute or chronic, though most childhood leukemias are acute. In acute leukemia, the onset is sudden and, worse, rapidly if not treated. Chronic leukemia is generally milder at the beginning and worsens slowly. Acute lymphocytic leukemia or acute lymphoblastic leukemia (ALL) and acute myelogenous leukemia (AML) are the most common types of leukemia in children.

Acute lymphoblastic leukemia (ALL) is also known as "childhood leukemia" because it is the most common childhood cancer and usually occurs between 2 and 8 years old. Acute

myelogenous leukemia (AML) is also called acute nonlymphatic leukemia, which usually occurs in people over age 25, but sometimes affects teenagers and children. Chronic myelogenous leukemia (CML) is also called chronic myeloid leukemia or chronic granulocytic leukemia, which is a slowly progressing disease and very rarely affects children (5 % percent of childhood leukemias). Symptoms of leukemia can be bone and joint pain, weakness, bleeding, fever, weight loss, and other symptoms like anemia. High WBC count is the main feature of majority of patients.

Brain and nervous system cancers: Brain and nervous system cancers are the second most common cancers in children and most common solid tumor cancer in childhood (about 21% of childhood cancers). The most common brain tumors are called gliomas, which occur mostly in children from birth to



CANCERS In Children

Parents and doctors can explain cancer as a battle between "good" cells and "bad" cells.

15 years old. Most brain cancers of children involve the cerebellum or brain stem. Early symptoms are headaches, nausea, vomiting, blurred or double vision, dizziness, and trouble in walking or handling objects.

Neuroblastoma: This form of cancer is the second most common solid tumor cancer in children (about 7% of childhood cancers). This cancer starts in certain types of nerve cells found in a developing fetus and hence occurs in infants and young children, generally found during the first year of life. It is rarely found in children older than 10. This tumor usually occurs in the abdomen and is noticed as swelling. In majority of cases of neuroblastoma, increased levels of catecholamines or its metabolites (dopamine, homovanillic acid and vanillylmandelic acid) are found in the urine or blood.

Wilms' tumor or nephroblastoma: This cancer starts in one, or rarely, both kidneys. It is the most common type of kidney cancer in children (about 5% of childhood cancers), but is different from kidney cancer in adults. This cancer can occur in children of 6 months to 10 years of age, but occurrence is maximum in first five years of life. It is most often found in children about 3 years old and rare in children older than six years of age. It can be noted as a swelling or lump in the abdomen. Other symptoms include fever, pain, or poor appetite. Heredity may play a role in the pathophysiology of this cancer.

Retinoblastoma: It affects the retina. It is rare (less than 3% of childhood cancers). Some children have hereditary occurrence of retinoblastoma. It usually occurs in only one eye, rarely both eyes, and mostly in children younger than 5 years of age.

Soft Tissue Sarcomas: These cancers start in soft tissues, which connect, support, and surround body organs.

Rhabdomyosarcoma is the most common type of soft tissue sarcoma (about 3% of childhood cancers). It starts in muscle tissue and affects children of 2 to 6 years of age. Symptoms include pain and swelling (a lump).

Liver cancers (Hepatoma): It is a rare disease and of two types: Hepatoblastoma (can be inherited and generally occurs before 3 years of age) and hepatocellular cancer (more likely in children infected with hepatitis B or C and occurs usually in children under 4 years of age).

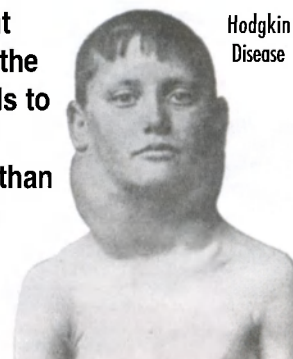
Bone cancers: Primary bone cancers (cancers which start in the bones) occur most often in children and adolescents. Primary bone cancer is different from metastatic bone cancer, in which cancer originates elsewhere in the body and spreads to the bone. Metastatic bone cancer is more common than primary bone cancer. Two types of primary bone cancers occur in children.

Osteosarcoma (osteogenic sarcoma) is the most common type of bone cancer in children (6th most common cancer in children) and constitutes approximately 3% of all new childhood cancer cases. It occurs in the age group of 10 and 25 years. It often causes no pain or symptoms, but sometimes there is bone pain that keeps getting worse.

Ewing's sarcoma is a less common primary bone cancer (about 1% of childhood cancers), which can cause bone pain and mostly found in adolescents. Ewing's sarcoma commonly occurs in hipbones, long bones in the thigh (femur) and upper arm (humerus), and ribs.

Lymphomas: Lymphoma is a tumor of the lymph tissue and can start anywhere in the body. Lymphomas are the third most common childhood cancer, but are rare in children under 5 years. Two main types are Hodgkin lymphoma (Hodgkin's disease) and Non-Hodgkin lymphoma. These cancers start in lymph tissues, such as the tonsils, lymph nodes, and thymus. These cancers can cause different symptoms depending on where they are growing. They can cause symptoms like fever, night sweats, weakness, and swollen lymph nodes. Patients with a weakened immune system, have a

Treatment will help the good cells to become stronger than bad cells



higher incidence of lymphoma.

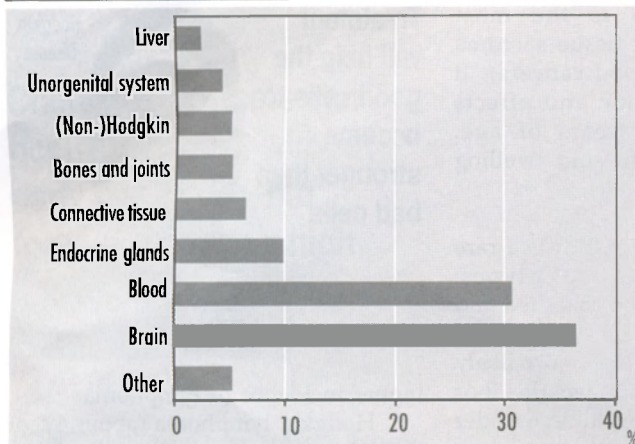
Hodgkin lymphoma (about 4% of childhood cancers usually affects the lymph nodes that are close to the body's surface, (in the neck, armpit, or groin area). Non-Hodgkin lymphoma (about 4% of childhood cancers), affects lymph nodes that are found deeper in the body of children. The bowel is mostly affected, often in the area near the appendix.

Causes, Symptoms & Diagnosis

Causes: The factors that cause cancer in children are generally not the same that can cause cancer in adults (smoking or exposure to environmental toxins). In majority of cases, childhood cancers arise from non-inherited mutations (random and unpredictable) in the genes of growing cells. Rarely, there is an increased risk of childhood cancer in children with genetic diseases like Down's syndrome. Children who have had chemotherapy or radiation treatment for a previous cancer may also have an increased risk of future cancer occurrence.

Symptoms: Symptoms of cancer like fever, swollen glands, recurrent infections, anemia etc. are also associated with other non-cancerous conditions. Hence doctors can miss early signs of cancer. Therefore, even a small symptom with low suspicion of malignancy should be verified with more confirmatory tests.

Diagnosis and Staging: To confirm the diagnosis of cancer, physical examination, laboratory tests like complete blood count (CBC), tumor markers, X-ray, Ultrasound, CT, PET or MRI scan and biopsy are done. After the child's cancer has been diagnosed, many tests are done to determine the amount and spread of cancer in the body, which is called staging. Staging



Occurrence of childhood cancer (left)

In acute leukemia, the onset is sudden and, worse, rapidly if not treated.

must be done to decide the most appropriate treatment and best outcome. To stage solid tumors, the doctor examines the size of the tumor, the affected lymph nodes and surrounding area. To stage leukemia, the doctor checks the bone marrow, liver, spleen, and lymph nodes. Many different tests can be used in staging, such as X-rays, MRI, CT or CAT scans, and others. After child's staging is complete, the treatment team develops a plan that outlines the type and duration of treatment.

Treatment

The treatment of cancer in children can include chemotherapy (the use of medicines to kill cancer cells), radiation (the use of radiant energy to kill cancer cells), and surgery (to remove cancerous cells or tumors). The type of treatment depends on the type and severity of the cancer and the child's age. For children with leukemia or lymphoma (which involve circulatory system and lymphatic systems located throughout the body), surgery generally plays a minor role. For these cancers, chemotherapy is the best option.

However, in children with solid tumors that do not metastasize (haven't spread to other parts of the body), surgery can effectively remove cancer when used in combination with chemotherapy and/or radiation. Children with certain types of cancer may receive bone marrow transplants. Many types of childhood cancer are treated with radiation in combination with chemotherapy or surgery.

Many drugs used in chemotherapy carry the risk of side effects, both short-term (nausea, vomiting, hair loss, fatigue, anemia, increased risk of

infection due to destruction of the bone marrow, kidney damage, bladder inflammation, liver damage etc.) and long-term (infertility, growth problems, organ damage, or increased risk of other cancers).

Effect of Cancer on Child

Children with cancer may feel worried and afraid sometimes, may find it hard to talk about these fears and may behave abnormally. The child may become louder or quieter than usual, show changes in eating habits, not do well in school, or resume earlier behaviors such as thumb sucking. Parents may need to talk about such changes with the doctor, nurse, social worker, teachers, and school counselor.

Children often worry about how their friends and classmates will act toward them, especially if they have missed a lot of school or return with physical changes, such as hair loss. Other students are usually accepting, but they may have questions, which can be clarified by parents and doctors. In children with cancer, replacing fear and misunderstanding with compassion and information should be the goal to cope with the illness.

Role of Parents

Role of parents in management of childhood cancer is the greatest. Parents should equip themselves with information about the type of cancer and stage of the disease, tests required and whether they are painful, choices (including a clinical trial), schedules, durations, success rates and side effects (immediate and long term) of treatments, the best place to receive the treatment (home or hospital), and duration of hospital stay.

Children usually know when something is wrong (not feeling well, frequent doctor/hospital visits, having many tests etc.). It is important to be open and honest with the child. Being honest lets the child know that parents understand and accept his/her feelings and helps the child trust parents. Talking with the child about cancer prevents misconceptions, reduces stress, increases child's cooperation for treatment, increases family bonding and makes dealing with the cancer easier for everyone.

Care should be taken to avoid feelings of depression in the child. How much information should be told depends on the age of the child and level of understanding. When cancer affects younger children (younger than age 4), parents can tell them that they are "sick" and need "medicine" to get better which is sufficient. In case of older children, facts about the specific type of cancer and its effects should be explained.

When the child asks, "Why did I get cancer? Or 'Why me?'," parents should emphasize that cancer is neither his/her fault, nor contagious. The child can be told that cancer is a serious disease, but that treatment (medicine, radiation, or an operation) has helped get rid of cancer in many children, and doctors are trying their best to cure his/her cancer, too. Presence of caring people around makes the child feel more secure.

It is important that the child's fears are properly addressed. Parents should explain ahead of time about the cancer, treatment, and possible side effects in a positive way. For example, parents and doctors can explain cancer as a battle between "good" cells and "bad" cells, and treatment will help the good cells to become stronger than bad cells and when good cells destroy the bad cells, he/she can feel better and play without getting tired. Whenever possible, options could be given to the child, like taking medicine mixed with his/her favorite fruit juice.

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Dendrimers

New Hope For Cancer

When the full potential of dendrimers is determined, the agonies of cancer patients could be alleviated to a large extent

NANOMATERIALS are man-made nano-sized (typically 1-100 billionths of a meter) materials for medical applications. The physical properties of materials change dramatically at the nano level. As these materials approach the scale of biological materials, it allows them to interact with cells and other biological structures in new and unprecedented ways. This makes nanomaterials particularly effective in the monitoring, repair, assembly, and control of biological systems, molecules, and structures.

A class of nanomaterials called dendrimers have been found particularly useful in cancer treatment. Dendrimers have often been referred to as the "Polymers of the 21st century". The name 'Dendrimer' comes from the Greek *dendron*, meaning, "tree". They are nearly perfect monodisperse (a consistent size and form) macromolecules with a regular and highly branched three-dimensional architecture having an average size of around 5×10^{-9} m, which can be artificially synthesized.

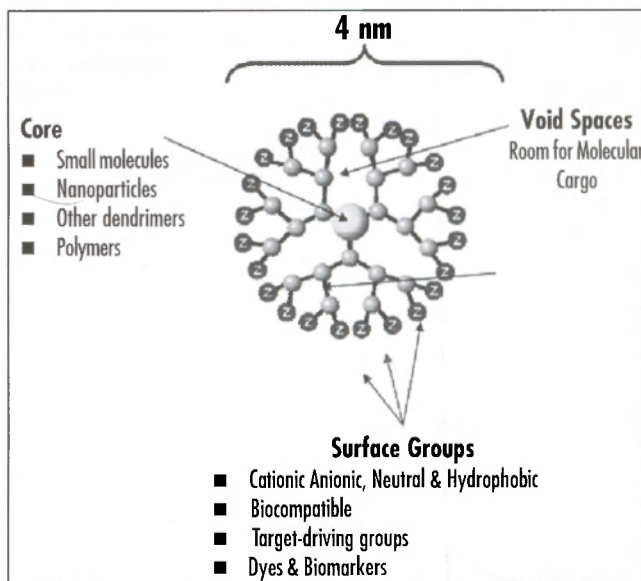
As is evident from the above comparison, the biggest of the Dendrimers is much smaller than any of the cell organelles found in the cell. In fact they are much smaller than the smallest of the virus! This property makes it ideal to be used in various biological applications.

How are Dendrimers Synthesized?

If we want to visualize a dendrimer, we should think of a tree in which each of its branches divides into two new branches after a certain length. This continues repeatedly until the branches become so densely packed that the canopy forms a globe. A typical dendrimer consists of three major architectural components: core, branches, and end groups. The branches are interlinked polymerized chains of molecules, each of which generates new chains, all of which converge to a single focal point or core. During synthesis, these chain-ends can be designed to perform specific chemical functions.

There are two defined methods of dendrimer synthesis, Divergent synthesis and Convergent synthesis.

Divergent synthesis assembles the molecule from the core, extending radially to the periphery whereas in



Convergent synthesis it starts at the surface and proceeds inwards, before the attachment of pre-synthesized dendrons to the core.

The Core molecule is referred to as "Generation 0." Each successive repeat unit along all branches form the next generations, "Generation 1," "Generation 2," and so on until the terminating generation.

The first dendrimers were synthesised using divergent synthesis by Vogtle in 1978. Dendrimers are considered to be "wonder molecules" because of the unique properties associated with them over conventional polymers.

Dendrimers and Cancer

The field of oncology could soon be revolutionized by novel strategies for diagnosis and therapy employing dendrimer-based nanotherapeutics. Conventional cancer therapy faces some problems:

- Most cancer therapeutics are small drug molecules that after being ingested or injected into the bloodstream and find it difficult to diffuse through vascular pores and the extracellular matrix to reach tumors, as studies have

Properties of Dendrimer vs Linear polymers

Property	Dendrimers	Linear Polymers
Structure	Compact, Globular	Not compact
Synthesis	Careful & stepwise growth	Single step polycondensation
Structural control	Very high	Low
Architecture	Regular	Irregular
Shape	Spherical	Random coil
Crystallinity	Non-crystalline, amorphous materials	Semi crystalline/crystalline materials
Aqueous solubility	High	Low
Nonpolar solubility	High	Low
Viscosity	Non linear relationship with molecular weight	Linear relation with molecular weight
Reactivity	High	Low
Compressibility	Low	High
Polydispersity	Monodisperse	Polydisperse

documented that molecules that are 100 nm or more in diameter do not effectively diffuse across the vascular endothelium. Even molecules 40 nm in diameter are problematic unless the endothelium is traumatized by radiation or heating.

■ Tumors often require higher doses of therapeutics since they have developed mechanisms of evading anticancer drugs or have developed resistance against them. As such the dosage concentration has to be increased which leads to side effects on the neighbouring healthy cells as well.

■ It is necessary to monitor the response to therapy by identifying residual disease immediately after treatment. This is crucial since a few remaining cells may result in re-growth or worse, lead to a tumor that is resistant to therapy.

An ideal therapeutic, therefore, must be able to target only the cancerous cells by sensing its signatures, image the extent of the tumor growth and monitor cells for their response to the drug administered.

Scientists agree that it is possible to design specific dendrimers that can not only identify specific targets on cancer cells but also deliver one or more therapeutic agents to specifically kill the abnormal cells without collateral damage to the neighbouring healthy cells.

For achieving this objective a "Trojan Horse" strategy could be employed which will involve targeting the tumorous cells by charging the dendrimers with folate as a ligand. Folate has good solubility, binds to its receptor on cancerous cells with high affinity while being conjugated to a wide array of conjugates, including protein toxins, radioactive imaging agents, MRI contrast agents, liposomes, gene transfer vectors, antisense oligonucleotides, ribozymes, antibodies and even activated T-cells. Upon binding to the folate receptor, folate-conjugated drug conjugates are shuttled into the diseased cell.

Now, if the same dendrimer ligated to folic acid is charged with anticancer drugs such as cisplatin and doxorubicin, it will kill the tumour cells after entering the same. Experiments have proven that dendrimers charged with anti-neoplastic drugs like Methotrexate with folate as ligand become 5-10 times more potent in killing tumorous cells than when the drug is delivered in a conventional manner.

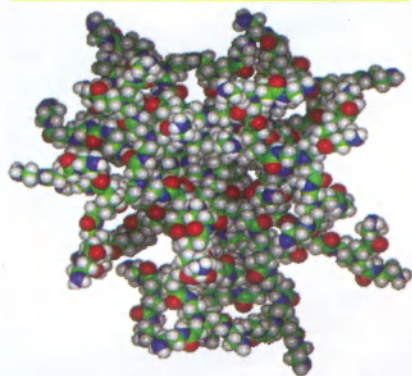
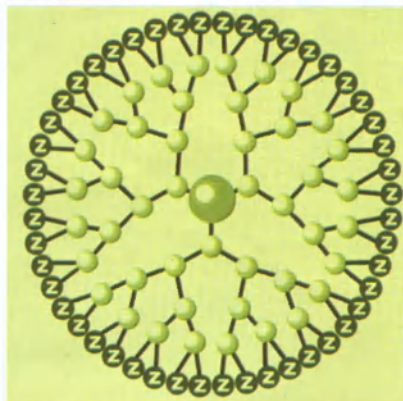
Another attractive proposition has been the use of monoclonal antibodies that recognize and selectively bind to tumor-associated antigens (TAAs). Such a molecule will be an immunotoxin, which are antibody-toxin chimeric molecules that kill cancer cells by binding to a surface antigen, internalization and delivery of the toxin moiety to the cell cytosol. The synthetic ability to attach both a tumor-targeting antibody and a potent payload of anticancer drugs to the same dendritic molecule provides a platform for multifunctional nano-scale drug delivery devices. Results from studies have revealed that when administered *in vivo*, antibodies can direct dendrimer-associated therapeutic agents to antigen-bearing tumors.

Efforts are on to make vaccines against cancer by the presentation of oligosaccharides on the dendrimers that are found only on the cancer cells, thereby stimulating the immune cells to produce antibodies against the same.

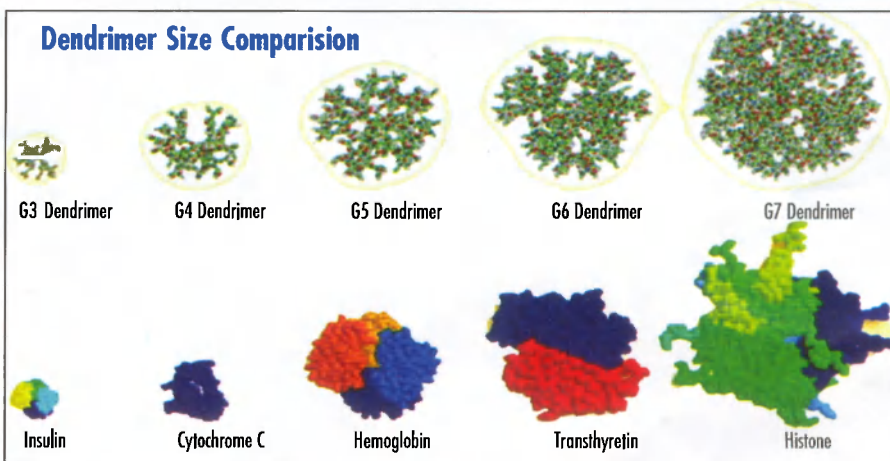
Scientists are also designing a new form of dendrimer where different dendrimers with different functions are clustered using complementary oligonucleotides that are attached to each dendrimer. This approach allows greater flexibility than using a single dendrimer with multiple functions, as the clusters are self-assembling without additional chemical alterations that could harm the units. These oligos are susceptible to nuclease digestion, which would allow the breakdown of the device after it is delivered to the cells. The fragments would be eliminated through the kidney.

Applications of Dendrimers in Cancer Treatment

1. Diagnosis using Imaging techniques: Dendrimers have also been conjugated to fluorochromes and shown to enter cells. As they can be used as novel contrasting agents that target only the affected cells, they can then be detected within the cell with sensing apparatus. This feature has made it possible to characterize cell targeting, surface binding, uptake and internalization, and even sub-cellular localization. In fact, Gadolinium, a contrasting agent has been conjugated to a folate receptor or Tumor associated antigen (TAA) dendrimer to target and study the cancer cells.



Dendrimer Size Comparison



2D (top left) and 3D (left) representations of a Dendrimer

The physical properties of materials change dramatically at the nano level.

2. Photodynamic therapy: Photodynamic therapy (PDT) is a treatment that uses a drug, called a photosensitizer or photosensitizing agent, and a particular type of light. When photosensitizers are exposed to a specific wavelength of light, they produce a form of oxygen that kills nearby cells.

In conventional treatment when the agent is administered, it enters every cell of the body but has a longer retention time in the cancerous cells. As such when specific radiations are given to cells after a gap of 24-72 hours, when most of the agent has left normal cells but remains in cancer cells, the tumor is exposed to light. The photosensitizer in the tumor absorbs the light and produces an active form of oxygen that destroys nearby cancer cells. This therapy is not foolproof as the photosensitizer may remain in the healthy cells also which may get killed on exposure to light.

Once inside the cell, the gene enclosed in the particle recognises the cancerous cells and kills them. Scientists are hopeful that the human trial can begin by 2011.

A dendrimer docks on cellular folate receptors, which are over-expressed on the surface of cancer cells.

Dendrimers can play a vital role in PDT as they can be designed to deliver the agent only to the affected tissues by recognizing the specific molecules on the same. This will fasten the rate of treatment for one doesn't have to wait for the elimination of photosensitizer from the normal cells. This will also lessen the chances of destruction of normal cells significantly.

3. Boron neutron capture therapy (BNCT): Successful treatment of cancer by boron neutron capture therapy (BNCT) requires selective delivery of sufficient number of stable non-radioactive isotope of Boron. BNCT is a binary radiation therapy where a beam of low-energy neutrons is given to a stable isotope of boron (boron-10) after they have accumulated in the tumor cells. Boron present in or adjacent to the tumor cells disintegrates after capturing a neutron thereby producing high-energy heavy charged particles that destroy only cells in close proximity to it, primarily cancer cells, leaving adjacent normal cells largely unaffected.

But in the conventional Boron transfer mechanism where polymers like polylysine are used, we could deposit only 1700 boron derivatives to the target tissue. This results in much lesser number of boron depositations in the target cell than needed. As a result the effectiveness of the treatment is considerably affected. But if we use dendrimers like PAMAM, we can load and transfer about 5000 boron derivatives.

4. Gene therapy: Dendrimers seem to offer many advantages over viruses as vehicles of genes. They may be much less toxic, and they may offer other advantages in terms of cost, ease of production, and the ability to transport very long genes. It has been found that polypropyleneimine dendrimer nanoparticles have the capacity for tumour transfection - the process of introducing nucleic acids into cells by non-viral methods in tumour-bearing mice. Once inside the cell, the gene enclosed in the particle recognises the cancerous cells and kills them. Scientists are hopeful that the human trial can begin by 2011.

Research in the field of dendrimers has brought a ray of hope in our fight against cancer. We hope that when the full potential of this nanoparticle is determined, we could alleviate the agonies of cancer patients to a large extent.

Mr Subha Sankar Ghosh, North East Rabindrapally, P.O.: Nona Chandanpukur, Dist- 24 Parganas (N), West Bengal-700122; Email: subhasankarghosh76@gmail.com

Role of Bioinformatics in Cancer

Bioinformatics has today come to the aid of cancer research, to seek out the mysteries of cancer progression and has also contributed to the development of targeted therapies.

APARNA CHAUDHURI & SANTANU CHAUDHURI

The difference between life and matter is information. The information is located in the one-dimensional DNA sequence, which is translated with the help of the genetic code to the one-dimensional sequence in protein. The one-dimensional sequence of the protein determines the 3D structure of protein. The 3D structure of protein enables specific biochemical reactions to be speeded up. This sustains structures essential to life. In the end information is the difference between life and matter, between biology and physics. Information is the ultimate explanation of life. Information is the secret of life.

Hubert P. Yockey
Author of

Information Theory and Molecular Biology

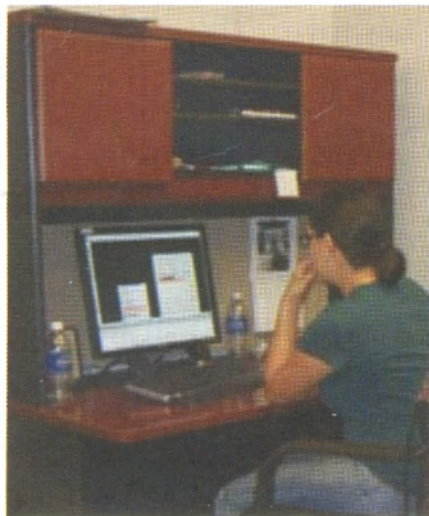
A genetic disease is a disease that is caused by defective or abnormal genes inherited from the parents or due to some external factors causing abnormal changes in the genetic profile. Detection of all of the defective genes is always not possible because all of them may not be manifested in the phenotype. Besides, the genetic dictionary of a human being is huge and very complicated.

During the last decade, the technology for measuring cellular (and even molecular) level biologic phenomena has rapidly improved. In addition to recording and analyzing clinical outcomes following treatment for cancer, it is now possible to measure the way genes and proteins are

expressed in tumours and, in some instances, to measure the genomic (gene related) or proteomic (intra cellular protein metabolism related) response to tumours following therapy. The promise of this technology is that it will allow for the development of treatments specifically targeted to the genetic irregularities that are the cause of growing and spreading malignancies.

Bioinformatics is the art and science of electronically representing and integrating biomedical information, that is, the genetic makeup, in a way that makes it accessible and usable across the various fields of cancer research.

All the fields of cancer research generate huge amounts of data. The challenge to the scientists is to use the data and draw the right



conclusion. Different sets of data obtained from different experiments should interact and give proper result. The new silico biology helps researchers conduct virtual experiments using large amounts of data obtained from various sources and build computer models of biological structures. Information system is a vital tool to cancer researchers helping them integrate different languages and concepts.

Bioinformatics is used for predicting gene functions and predict which genomic changes could give rise to each known inherited disease, that is, identification of genes causing disease and also genetic therapies that can reverse disease phenotypes. Data obtained from functional genomics and proteomics is being used in drug designing and discovery.

Bioinformaticians continue to produce specialized automated systems to manage the sheer volume of sequence data produced, and they create new algorithms and software to compare the sequencing results with the growing collection of human genome sequences (genetic makeup) and germ line polymorphisms (changes in chromosomes of the mother cells which differentiate into different kind of cells constituting our body).

Biological Mark-up Language is also specially written to access the biological databases. This language is based on XML. Most biological databases contain data items that are enriched with text that explains the assumptions made in building up a data item. Sophisticated queries of biological database are an essential



When a normal stem cell erroneously transforms into a cancer cell, the biosensor would switch on a suicidal gene for self-destruction.

task in searching for laws governing biological data and processes.

For instance, Paul Eurich applied the selective affinity of dyes for biological tissues to postulate the existence of chemoreceptors. Eurich hypothesized that certain chemoreceptors on parasites, microorganisms and cancer cells would be different from analogous structures in host tissues and that these differences could be used for therapy. This led to the birth of chemotherapy.

Another field is pharmacogenetics that studies the hereditary differences amongst people. Because of these differences people react differently to the same drug. The DNA sequence of human beings varies from one person to another so the requirement of the drug concentration also varies from person to person. In pharmacogenetics, automated tools are used to determine the sequence of nucleotides, amino acid sequence and protein. Pharmacogenetics has identified specific chemotherapeutic agents that have very less toxic side effects on the patient but destroy the cancerous tumour.

Bio-simulation is a process that integrates the physiological data related to human disease and proteomic data to build a silico model. This data is used to show the change that occurred in the gene and protein sequence because of a particular disease. In future, these processes probably will be used to predict the cause and effect of a disease.

The identification of the drugable targets is also crucial for the

development of new drugs. A good quality target is one that is properly modulated and improves the clinical outcome in humans. Membrane protein is an important family of drug targets that is analyzed and validated by proteomic technologies. Target classification is again done by employing various bioinformatics approaches.

Large databases of organic molecules and existing drug molecules are available and these databases are used for virtual screening experiments. Successful generation of medicines requires two critical parameters i.e. quality of the drug target and its validation.

The human genome project has facilitated generic strategies for disease gene identification in a high throughput manner. Analysis of gene function is rapidly assessed in model organisms and human organ systems through several approaches that offer advantages to test drugs and gene functions in more than one model to better predict corresponding effects in humans.

The transcriptional profiles of most genes within a genome can be analyzed using micro arrays and quantitative analysis of micro array data. Transcriptional profile can help to generate gene expression data that can be used to define cell type or condition. There is a huge amount of data produced in any micro array experiment and hence computational methods are essential to conduct this analysis.

Within an organism, thousands of genes and their products express and interact with each other in a complicated and orchestrated manner and finally get translated into the action of life. Hence, it is very important to study the genes and their expression together rather than on a gene-to-gene basis. The micro array technology allows visualizing the activity of hundreds and thousands of genes simultaneously. This helps to monitor the entire genome on a single chip to give a clear picture of the interactions of thousands of genes simultaneously.

Micro array utilizes the preferential binding of complementary single stranded nucleic acid (cDNA) sequences. Micro array is built using a



Cancer Therapy

Genomics: This is a very powerful technology for target identification. Genomics provides vast amount of information to link gene activity with diseases. Almost 30 recessive and co-dominant oncogenes have been identified with the help of sequence data of cancer genomes. In order to detect all abnormalities, every human gene related to cancer mutations has to be screened for identifying deletion, insertion, substitutions and rearrangements.

Lethality Approach: This approach is used for drug targets and to detect difference between gene products in normal cells and tumour cells.

Disease Association: This is done by gene expression profiles of normal and abnormal cells with the help of micro arrays. Micro array technology is used in the area of functional genomics and gene annotation i.e. determination of the functions of large number of genes discovered in the sequenced genomes.

glass slide on to which cDNA molecules are attached at fixed locations. There are a large number of spots on an array, each containing a huge number of identical molecules of lengths from 20-100s of nucleotides.

Micro array is a technology that identifies the genes involved in a disease by comparing the gene expressions between tissues from healthy and infected person. These data also show the genes that are specially induced in specific tissues for drug development.

Cancer can be detected early through micro array data analysis, identification of alternative splicing isoforms, and prediction of over-expressed proteins getting into blood circulation.

Comparative hybridization experiments help to understand the genes that are preferentially expressed in specified tissues. This method is useful in drug designing. Gene expression pattern is useful in diagnosing and distinguishing different forms of cancer. Unlike some genetic diseases such as cystic fibrosis, which is caused by a single defective gene, cancer is generally heterogeneous but appears to be clinically similar to cystic fibrosis. For example, prostate cancer can be caused by several different and independent regulatory gene defects in a single patient. Hence, in a group of prostate cancer patients, each patient may have a unique set of missing or damaged genes with different implications for prognosis and treatment of the disease.

Comparative hybridization has been used in the study of cancer in two ways: first it can help to locate the transcription differences responsible for the change from normal to

cancerous cells, and second, it can distinguish different patterns of abnormal transcription in heterogeneous cancers.

The cell cycle is a biochemical process at the molecular level. Cancer is a genetic disease in which gene mutation transforms the normal cells into aberrant types gaining a potential of uncontrollable growth. The Cancer Genome Project was assigned the task of searching every human gene for cancer-related diseases. About 30 tumour suppressor and 100 dominant oncogenes have been identified so far, and the reason for this tardy progress has been attributed to the existence of functional redundancy in the human genome, making the task of identifying cancer genes a difficult one.

Modern chemotherapy drugs create undesirable side effects because they cannot differentiate between normal and cancer cells. In order to overcome the side effects drugs should be developed that can identify cell cycle targets that interfere with cell cycle regulatory pathway. Most cancers remain clinically unmet because they are generally multigenic. Cancer is a cell cycle disease in which all regulatory controls go haywire, allowing the tumour cells to divide at an abnormal speed.

The cell cycle provides opportunity to discover new targets for anti-cancer drugs and other therapeutic agents. The cell cycle is a biochemical process at the molecular level and its relevance in cell proliferative disease such as cancer and angiogenesis has assumed greater importance.

The research on cellular expressions of cancer is data intensive. Two softwares widely being used in this field are Bio-conductor and dChip.

The Bio-Conductor software, developed by Prof. Robert Gentleman, is based on a successful open source statistical language called R. dChip is a menu-oriented software developed by Prof. Cheng Li. This software helps in analysing gene expression levels that can be used by biologists. The dChip software helps to manage the huge amount of data produced by micro arrays. It helps in simultaneous interrogation of expression level of tens of thousands of genes.

Recent developments in cancer research have shown that the vast numbers of diversities in human protein arise from alternative RNA splicing. RNA splicing is a process that excludes or includes part of a gene to produce multiple protein isoforms from a single gene. The resulting isoforms can have different functions and are often an integrated part of early carcinogenesis.

Bioinformatics and high-throughput sequencing are being combined to identify cancer-specific protein isoforms. Such splice isoforms could potentially serve as biomarkers for early cancer detection. This will help to understand why some cells choose particular paths to carcinogenesis, as well as provide drug targets for cancer therapy. When a normal stem cell erroneously transforms into a cancer cell, the biosensor would switch on a suicidal gene for self-destruction.

Ms Aparna Chaudhuri is Lecturer, MCA Department, G.H. Raisoni Institute of Information Technology, Nagpur.

Dr Prof. Santanu Chaudhuri is a cancer specialist and Director, R.S.T. Regional Cancer Hospital and Research Centre, Manewada Road, Nagpur-440027.

KNIGHTS & KNAVES

Prize Puzzle

On a fictional island, all inhabitants are either knights, who always tell the truth, or knaves, who always lie. A visitor happens to land on the island and meets small groups of inhabitants. Three inhabitants named A, B, and C approach him. He asks A what type he is, but does not hear A's answer. B says: "A said that he is a knave" and C says "Don't believe B, he's lying!" What type of inhabitants are B and C?

ANSWER:

B =

C =

Contributed by K. Chetan, S/o Mr G L Navarathna Keshav, H.No 5894 (DUPLEX), Modern Housing Complex, Manimajra, CHANDIGARH-160101

There are three prizes of Rs. 500/- each for three correct entries. In case there are a large number of correct entries, the prize winner will be selected through a draw of lots. The decision of the Editor, *Science Reporter*, will be final.

Puzzle Corner
Science Reporter
 National Institute of Science Communication And
 Information Resources, CSIR, Dr. K.S. Krishnan Marg
 New Delhi-110012

Last date for the entries to reach us: 30-08-2010

Your Name :

Address :

.....Pin Code :

Age :Sex :

Occupation : ☐ Student ☐ Housewife ☐ Teacher ☐ Professional ☐ Retired ☐ Other

Educational Level: ☐ Primary ☐ Secondary ☐ Graduate ☐ Postgraduate

*Please fill up the questionnaire at the back

*Please note: Now you can even send your answers on a photocopy of this page.

MATCH THE BIOLOGISTS

- | | |
|--------------------------|----------------------------------|
| 1. Beadle & Tatum | [A] Operon concept |
| 2. Calmette & Guérin | [B] AIDS virus |
| 3. Darwin & Dana | [C] Urea cycle |
| 4. Singer & Nicolson | [D] Colorimetry |
| 5. Bateson & Punnett | [E] Enzyme kinetics |
| 6. Jacob & Monod | [F] Glycolysis |
| 7. Hershey & Chase | [G] DNA – genetic material |
| 8. Messelson & Stahl | [H] Immune deficiency syndrome |
| 9. Hardy & Weinberg | [I] Hybridoma technology |
| 10. Landsteiner & Wiener | [J] Origin of life |
| 11. Urey & Miller | [K] Rh blood group |
| 12. Briggs & King | [L] Antibody structure |
| 13. Porter & Edelman | [M] One gene one enzyme |
| 14. Kohler & Milstein | [N] Population genetics |
| 15. Wiskott & Aldrich | [O] Complementary genes |
| 16. Embden & Meyerhoff | [P] Semi conservative hypothesis |
| 17. Michaelis & Menten | [Q] Tuberculosis vaccine |
| 18. Beer & Lambert | [R] Coral reef formation |
| 19. Krebs & Henselait | [S] Cell membrane structure |
| 20. Montagnier & Gallo | [T] Nuclear transplantation |

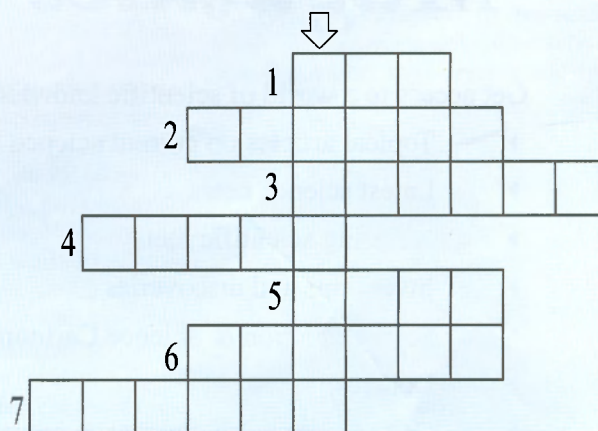
Contributed by Dr. K. Venkataraman, A-T-2, Porkudam Apartments, Bypass Road, Madurai-10

COLOUR QUIZ

Fill up the boxes horizontally according to the clues given below. If all your answers are correct, in the vertical column you will get a word used for beautiful arrangement of prismatic colours in nature.

Clues:

- One of the psychological primary hues
- A round fruit of the plant *Circus sinensis* or *C. aurantium*, having yellowish or reddish rind and a sectioned, pulpy interior with sweetish, acidic juice
- Dye that is obtained from the plant *Indigofera*
- Chlorophyll gives this colour to plants
- Colour of sky from earth, not from space
- The hue to the short-wave end of the visible spectrum, between 380 to 420 nanometers
- Red + Green =



Contributed by Mr Sanjay Kumar, Research Scholar, Plant Physiology Laboratory, Department of Botany, University of Allahabad, Allahabad-211 002 (U.P.)

Solutions to the puzzles published in the June 2010 issue:

PRIZE PUZZLE:

Complete the Grid

Option No. 3

Pyramid of Bones

- OS
- RIB
- ULNA
- FEMUR
- FIBULA
- SCAPULA
- CORACOID
- SYNSACRUM
- ACETABULUM
- EXOCCIPITAL
- ZYGAPOPHYSES
- HYOMANDIBULAR
- PALATOQUADRATE
- VERTEBRALCOLUMN
- WEBERIANOSSICLES

The names of the prizewinners based on a draw of lots from among the correct entries are:

(1) Garima Majithia,
H.No. 138/12, Guru Nanak Colony,
Near Preet Hospital, Patti, Distt. Tarn Taran,
Punjab-143416

(2) Angshuman Madhab Dutta,
C/o Dwijen Sarma, Govt. Ayurvedic College,
Jalukbari,
Guwahati, Assam-781014

(3) Yash Vinay Prabhu,
'Pratiksha', Indrayani Society, Lawrence Road,
Devlali Camp, Nasik, Maharashtra-422401

Congratulations all the winners!

It was a surprise to see a cart filled with miniature greenish black cow-skull like structures being sold by a vendor at Dharmaraya Temple road in Bangalore some time back. Later, the peculiar structures turned out to be fruits of *Trapa natans* L., an aquatic angiosperm belonging to the family Trapaceae. The local name was *Shingoda* or *Singhara*, as popular in North India. The vendor tried to localize the name by calling it 'neeru kadalaekai'.

Singhara is known by various names like 'bull nut', 'European water chestnut', 'water chestnut' and 'water nut'. *T. natans* L., an annual plant introduced from Asia, has become abundant in north-eastern United States where it creates a nuisance in lakes, ponds, canals and other slow-moving water bodies. It grows best in shallow, nutrient-rich lakes and rivers and is generally found in waters with a pH range of 6.7 to 8.2. This obnoxious weed out-competes native plants for sunlight and spreads either by the rosettes detaching from their stems and floating to another area, or more often by the nuts being swept by currents or waves to other parts of the water bodies.

The fruit can be eaten raw or boiled and used for preparation of curry after removing the outer thick shell. The fruit matures into a nut-like, barbed spiny fruit. The single-seeded woody fruits produced from the previous year germinate in early spring. Ungerminated seeds may remain viable for up to 12 years. However, most seeds probably germinate in the first two years. A single seed may give rise to 10 to 15 plant rosettes. Each rosette can produce up to 15 to 20 seeds. Currents or waves also carry nuts to other parts of the water bodies.

Investigations of archaeological material from southern Germany indicate that the prehistoric population of that region may well have relied significantly upon wild water chestnuts to supplement their normal diet and, in times of cultivated cereal crop failure, water chestnuts might

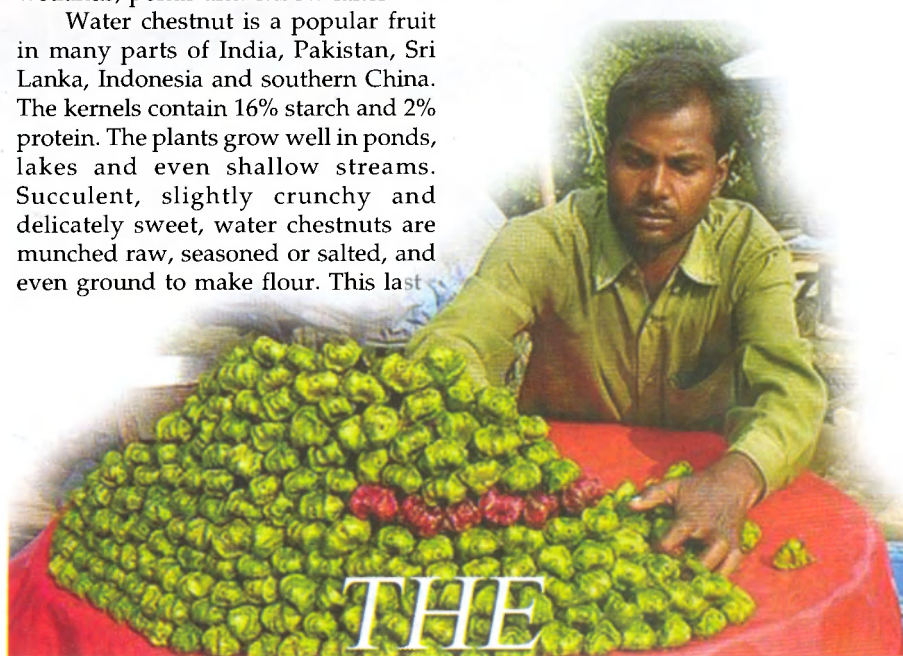
even have been the main dietary component. In the Chinese Zhou Dynasty, water caltrop was an important food for worship as prayer offerings where the worshipper "should use a bamboo basket containing dried water caltrops, the seeds of *Gorgon euryale* and chestnuts". The *Chinese Herbal Medicine Summary* indicates that water caltrop can help fever and drunkenness.

It was possible to buy water chestnuts in markets all over Europe until 1880. In northern Italy the nuts were offered roasted, much as sweet chestnuts are still sold today. At many places in Europe water chestnuts were known and used for human food until the beginning of the 20th century. Today, however, it is a rare plant. There may be several reasons for its near extinction, such as climate fluctuations, changes in the nutrient content of water bodies, and the drainage of many wetlands, ponds and oxbow lakes.

Water chestnut is a popular fruit in many parts of India, Pakistan, Sri Lanka, Indonesia and southern China. The kernels contain 16% starch and 2% protein. The plants grow well in ponds, lakes and even shallow streams. Succulent, slightly crunchy and delicately sweet, water chestnuts are munched raw, seasoned or salted, and even ground to make flour. This last



quality makes it a favourite in Northern India for those who abstain from cereals during religious fasts: the flour (*singhare-ka-atta*) is a staple food material in many a household during the October-November festive season. *Puris*, and a sweetmeat called *kattle* are some popular savouries made from water chestnut flour.



THE FORSAKEN WATER CHESTNUT!

V.K. HARIDASAN & G. RAVI



The plants grow well in ponds, lakes and even shallow streams. Succulent, slightly crunchy and delicately sweet, water chestnuts are munched raw, seasoned or salted, and even ground to make flour.



Milk suppliers often use its powder in milk to make it creamier. Harvested between October and December, water chestnuts are valued in traditional systems of medicine, such as the Ayurveda, for their cooling and astringent properties. They are reputed to reduce heartburn, fatigue and inflammation and are also useful against blood disorders, urinary tract infections, bad breath, toothaches and dehydration. The fruits are useful in burning sensation, dyspepsia, leprosy and dysentery.

Water chestnut is nutritious and a good source of potassium and vitamin B. It contains antioxidants, which may help reduce wrinkles and protect skin from ultraviolet rays. Many bioactive agents in water chestnut help reduce hair loss. The water chestnut ointment and lotion may help reduce inflammation and pain caused by sprains and other injuries. The rind of water chestnut exhibits antimicrobial activity.

But it is a menace too. The spines of chestnut fruit in lakes can penetrate shoes. This plant also severely limits the passage of light into the water, a critical element of a well-functioning aquatic ecosystem. It reduces oxygen levels, which may increase the potential for fish kills. Water chestnut also limits boating, fishing, swimming and other recreational activities. Fasciolopsiasis, an infection caused by the largest intestinal fluke of humans can be transmitted from the surface of the aquatic plants like *T. natans* L. From there they can be passed on to pigs, humans and other animals by raw consumption. Because of this reason and also possible toxicity from polluted water, the kernels should be boiled for an hour before consumption.

Regulated cultivation of water chestnut is quite economical because of the various uses that the fruits have. Smaller populations can be removed by hand. *T. natans* L. roots are easily uplifted. Their removal is imperative

because floating uplifted plants can further spread their shedded seeds downstream.

The potential of *T. natans* L. seeds to lay dormant for up to 12 years makes its total eradication difficult. Hand harvesting from canoes and raking has been effective and is also a means to promote community involvement. For large-scale control of *T. natans* L. populations, which can form dense, thick mats capable of covering miles, the chemical method is employed by using herbicides along with mechanical harvesting. Aquatic plant harvesting boats are often employed in instances where waterways are blocked and herbicide (2,4-Dichlorophenoxy acetic acid) has been tested and deemed safe.

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Ginkgo biloba, known as the maidenhair tree, fossil tree, "Baiguo" (white nut), "Yajiao" (duck foot), "Gongsunshu" (grandfather/grandson tree), "Yinxing" or "Icho" (silver apricot) is one of the oldest trees on Earth. It has been called a "botanical dinosaur" because it has remained on Earth for 200 million years and more—with almost no change to mark the passage of time. The present day *Ginkgo* has recognizably similar fossils dating back 270 million years.

During the age of the Dinosaurs, the genus *Ginkgo* is thought to have had 200 living species of which *Ginkgo biloba* is the sole surviving one. *Ginkgo biloba* is classified under the Order Ginkgoales, Family Ginkgoaceae. It is privileged (or lonely, depending on how you view it) to be the only member of the Family to which it belongs. It has no known close relatives still living on Earth.

The name *Ginkgo* is thought to come from the Chinese word sankyo or yin-kuo, meaning "hill apricot" or "silver fruit." Engelbert Kaempfer, the first Westerner to see the species in Japan (1690), gave the name *Ginkgo* (apparently the name was misread... G was used instead of Y). Linnaeus suffixed the term '*biloba*' to denote the fan-shaped leaf that has two lobes. Young *Ginkgo* trees are tall and slender. The crown becomes broader with age. Mature trees can reach more than 50m in height. Male and female flowers are carried on separate trees. Unfortunately, *Ginkgo* fruits stink like "rancid butter" or "vomit." *Ginkgo* has been used to make therapeutic products used in alternative systems of medicine for many hundreds of years.

For centuries *Ginkgo* was thought to be extinct in the wild. Kaempfer apparently sent the seeds of the *Ginkgo* to the Netherlands, making *Ginkgo* one of the first oriental trees widely



grown in the west as an ornamental shade tree. Interestingly, the *Ginkgo* had also survived in the wild in China (where it most probably had originated). From China, it is speculated that Buddhist monks took the seeds to Japan and Korea. Since *Ginkgo* fossils are found on all continents, its restricted native range is most likely because of changing climate.

*Ginkgo*s are long-lived because of their resilience and remarkable resistance to disease, pests, fires and tolerance of air pollution. Reportedly, at least six *Ginkgo* trees survived the Hiroshima atom bomb explosion. One of these was near a temple in Housenbou, which was only 1km from the centre of the blast. The temple was totally destroyed but the tree was in bud when examined a month later. The temple was rebuilt (1994) with entrance steps built on both sides of the now flourishing tree. Engraved on it are the words, "No more Hiroshima" and people's prayers for peace. It is a symbol of survival and the triumph of hope.

Sir Albert Charles Seward (1863–1941), botanist and geologist put it most poetically when he said, "It appeals to the historic soul; we see it as an emblem of changelessness, a heritage from worlds too remote for our human intelligence to grasp, a tree which has in its keeping the secrets of the immeasurable past." It is almost impossible to sum up better, the *Ginkgo*'s appeal.



During the age of the Dinosaurs, the genus *Ginkgo* is thought to have had 200 living species of which *Ginkgo biloba* is the sole surviving one.

This *Ginkgo* survived the atom bomb

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Potential Peril

CALL it a potential peril or a hidden hazard but the fact remains that Limnic eruption is a rare natural hazard, which is no less deadly because of its rarity. Although Limnic eruptions sometimes walk hand in hand with tsunamis, there are no fiery explosions involved, no lahars, no lava flows, no avalanches, no cyclones or typhoons...yet the danger to life is no less real. Limnic eruptions are killers in their own right, albeit silent ones and it is a killer despite the fact that only two cases have been documented in recent times.



A Limnic eruption (aka Lake overturn/rollover) is the sudden eruption of carbon dioxide from deep lake water. The carbon dioxide smothers and kills. It is sudden, it is silent and it is a sinister killer.

Liquidating Life

On 15 August 1984, 37 people were mysteriously suffocated to death near Lake Monoun (Cameroon). There were reports of a sound like that of an "explosion" and there was also an earthquake 6 km north of the location. Just two years later, on 21 August 1986, about 1800 people were killed, near Lake Nyos (Cameroon) amidst reports of a "strange white cloud." Reportedly, the formation of the cloud was preceded by the sound of rumbling. Then, a jet of frothy spray shot up from the lake. A white cloud collected over the water, and it rapidly grew 80-100 meters tall and flowed across the land.

The cloud was about 50 meters thick and it rolled down the slope at ~70 km per hour bringing death in its wake. It persisted in a concentrated form over a distance of 23 km and all living beings perished wherever the cloud passed over. The water of the lake became rusty brown instead of the sparkling blue that it had once been.

The cause of death appeared to be suffocation. Rescuers reported that the victims appeared to be "sleeping" and that

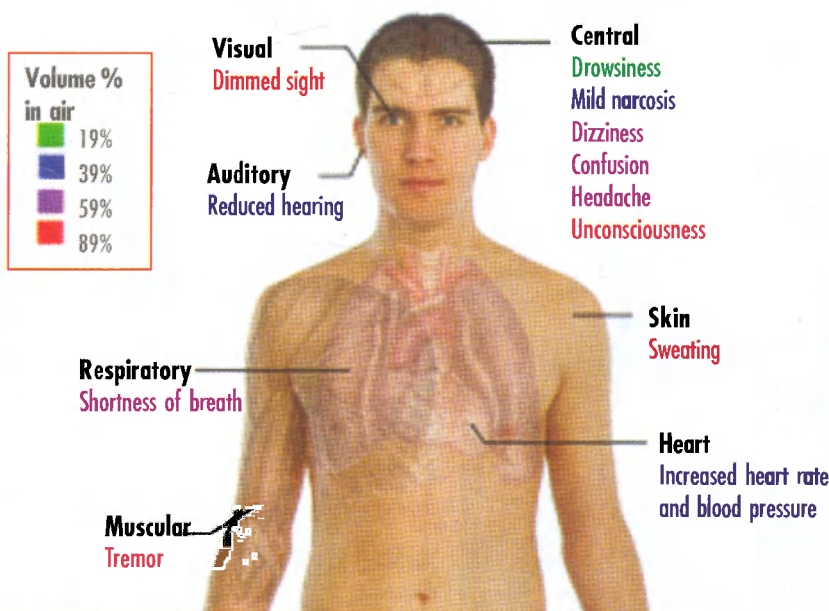
there were little or no signs of trauma to the bodies. Vegetation was flattened for 100 meters around the eastern end of the lake but otherwise plant-life remained unaffected. Apparently, the damage was caused by a 5-meter tsunami-like wave that was triggered when the 'something' erupted violently from the water.

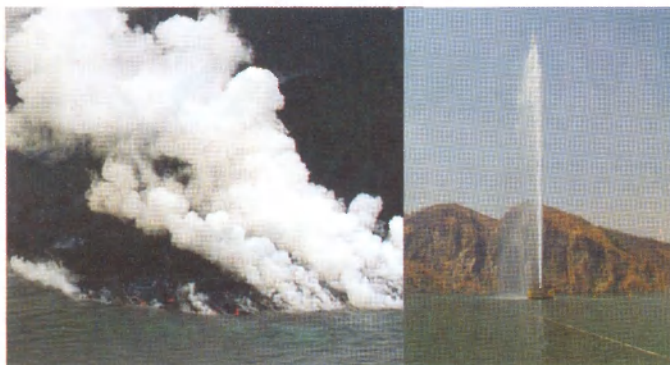
Listing Cause

Scientists soon realized that the 'something' was a mixture of carbon dioxide and water

droplets. Carbon dioxide normally makes up ~0.03% of air and concentrations of more than 10 per cent can be fatal. Being heavier than air, it settles like a blanket cutting off access to regular air. In desperation a person gasps, and the more a person gasps for air, the more carbon dioxide enters the system. The question that then arose was: From where did this carbon dioxide cloud surface? Of course, the How and the Why behind the eruption also engaged scientific attention.

Main symptoms of Carbon Dioxide toxicity





Lake Kivu steams when lava enters water (extreme left)

Degassing the Kivu Lake (left)

Kivu Lake before and after the eruption (below)



Scientists studying the build-up of carbon dioxide in the bottom layers of lake water realized that volcanic activity constantly releases carbon dioxide into these lakes.

The change in the colour of the water of Lake Nyos was because iron from the lake's bottom was brought to the surface where it oxidized, leading to the brown rust colour.

Lake Overturn Long Ago

Although Lake overturn has only just recently caught contemporary attention, there is evidence that Messel Pit (Germany) – one of the richest fossil sites in the world – was witness to Limnic eruptions too. The eruption killed (and the soil perfectly preserved) early Eocene fauna (approx. 57 million-36 million years ago). In Lake Kivu, scientists George Kling and Robert Hecky (University of Michigan) have found evidence in sediment cores that there has been explosive gas release in the past.

Likely Limnic Eruptions

Even today, Lake Nyos and Lake Monoun contain significant amounts of dissolved carbon dioxide. Lake Kivu contains methane in addition to carbon dioxide in its deeper layers. It is thought that bacteria in the lake produce the methane. Additional causes for concern are that Lake Kivu is many times larger than Lake Nyos, is close to Mount Nyiragongo, an active volcano, which could serve as a trigger, and the lake is located in a more-densely populated area, which could mean a worse tragedy should the lake erupt.

Leashing Lake Overturns

In 1990, a team of French scientists began experiments using siphons to de-gas the waters in a controlled manner. In 2001, an attempt was made to de-gas Lake Nyos using an electronic pump to simulate an eruption. Eawag, an aquatic research institute (Switzerland), has estimated that 90% of the dissolved methane in Lake Kivu is harvestable. In January 2010, scientists met to assess the potential of commercially viable methane extraction from Lake Kivu. According to an estimate, the methane in Lake Kivu is worth about \$20 billion. Not for nothing is it said that every threat is also an opportunity.

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Lesson Learnt

It soon became clear that both these lakes (called Limnically active or exploding lakes) had certain features in common. These were:

- Inflow of carbon dioxide-rich water
- Cool lower layer (no annual/cyclical mixing of water layers)
- Water layers had distinct temperatures and carbon dioxide levels
- Close to volcanoes

Scientists studying the build-up of carbon dioxide in the bottom layers of lake water realized that volcanic activity constantly releases carbon dioxide into these lakes. This carbon dioxide collects in the cold water at the bottom of the lake. Carbon dioxide dissolves much more readily when it is at a higher pressure. The deeper the lake is, the higher is the pressure at the bottom. Therefore, huge amounts of

carbon dioxide can be dissolved in large, deep lakes. Also carbon dioxide dissolves easily in cooler water, such as that at the bottom of a lake. Over time, the lowest levels of the lake become more and more saturated with gas. Trouble starts when saturation is reached.

Once the lake is saturated, only a small trigger is needed to set off the eruption. (However, Limnic eruptions can be triggered even before saturation point is reached.) As far as triggers are concerned, even small rises in temperature, landslide, earthquake, violent storm, or other disturbance of the waters serve well enough. The trigger pushes some of the saturated water (from the lower layer) higher in the lake, where the pressure is insufficient to keep the carbon dioxide in solution.

Then bubbles start forming, and the water is lifted even higher. A cycle begins, where even more of the carbon dioxide comes out of solution. This process forms a column of gas. At this point, the water at the bottom of this column is pulled up by suction, and it too loses its dissolved carbon dioxide. This leads to an eruption of the gas into the atmosphere and also displaces water to give rise to a tsunami.



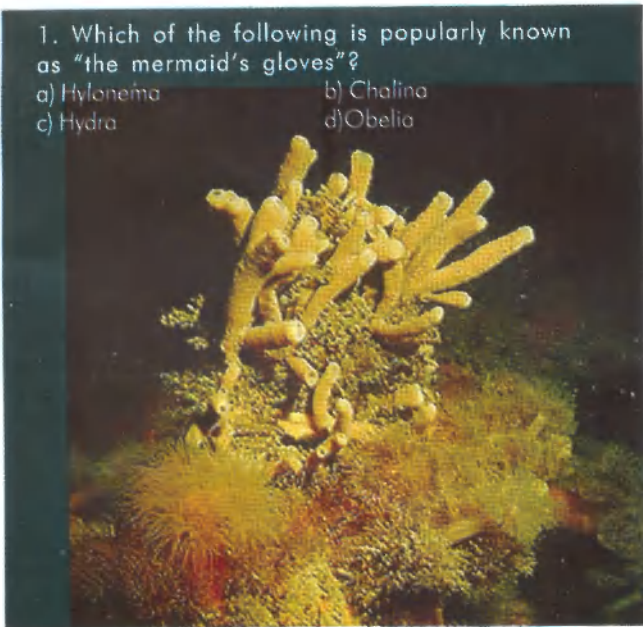
UNESCO Heritage for Fossils

WATER WONDERS

SHUCHISMITA BEHERA

1. Which of the following is popularly known as "the mermaid's gloves"?

- a) Hyloneima
- b) Chalina
- c) Hydra
- d) Obelia



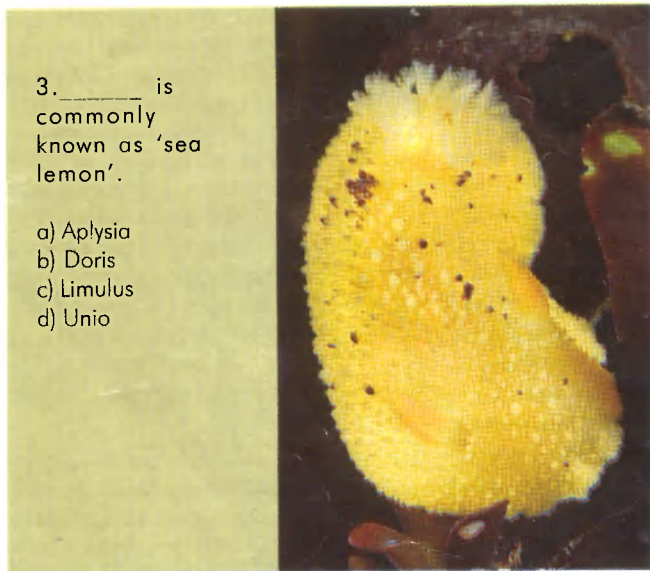
2. Which of the following is commonly called 'sea-fur'?

- a) Obelia
- b) Aurelia
- c) Hydra
- d) Octopus



3. _____ is commonly known as 'sea lemon'.

- a) Aplysia
- b) Doris
- c) Limulus
- d) Unio



4. In which of the following animals Aristotle's lantern is found?

- a) Scypha
- b) Corallium
- c) Aphrodite
- d) Echinus



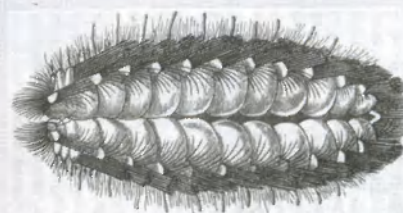
5. Which echinoderm is called 'feather star'?

- a) Antedon
- b) Clypeaster
- c) Cucumaria
- d) Ophiotrix.



6. Which of the following annelids is called 'sea mouse'?

- a) Earthworm
- b) Arenicola
- c) Nereis
- d) Aphrodite



7. Which of the following is known as 'hermit crab'?

- a) Eupagurus.
- b) Cancer
- c) Limulus
- d) Hippa



Fun Quiz

8. Which of the following marine protozoa is known to be luminescent?

- a) Ephelota
- b) Radiolarian
- c) Ceratium
- d) Polystomella.



9. _____ is commonly known as sea-pen.

- a) Gorgonia
- b) Pennatula
- c) Pennaria
- d) Plumularia



10. Which of the following is commonly known as 'sea-squirt'?

- a) Amphioxus
- b) Herdmania
- c) Balanoglossus
- d) Saccoglossus



11. Which of the following is commonly known as 'sea-horse'?

- a) Hippocampus
- b) Dugong
- c) Scoliodon
- d) Octopus



12. _____ is commonly known as 'sea-lion'.

- a) Seal
- b) Walrus
- c) Blue Whale
- d) Dolphin



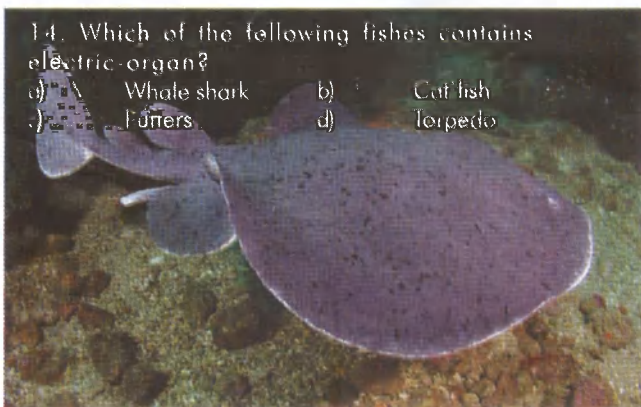
13. Which of the following is commonly called 'sea cow'?

- a) Shark
- b) Whale
- c) Dugong
- d) Seal



14. Which of the following fishes contains electric-organ?

- a) Whale shark
- b) Cat fish
- c) Eel
- d) Torpedo



ANSWERS:

- 1. b 2. a 3. b 4. d 5. a 6. d 7. a
- 8. c 9. b 10. b 11. a 12. b 13. c 14. d

Contributed by Ms Shuchismita Behera, Senior Research Fellow, Regional Medical Research Centre, Nalco Square, Chandrasekharpur, Bhubaneswar-751023, Orissa

ECO-GEEK-BICYCLE

Eco-geek bicycle is a hydrogen-fueled, power-assisted bicycle, which motors up to 15 MPH and takes you about 80 miles before you need to charge the batteries. When you're finished with all the hard labour of pedalling, the bike folds up neatly and can be tucked away in the trunk of your 9 MPG SUV.



STRESS BALLS

Stress balls are one of the most efficient stress management tools. Whether you squeeze it, twist it, or smash it, it sure will help release the tension and stress that are building up in the muscles of your hands.

Aside from that, it also helps in strengthening your hand's muscles as well as in improving joint flexibility. No matter if you're an employee, or you're the boss, you sure get stressed out by the tasks assigned to you or by the people around you. But if you have a USB stress ball, you'll feel much better after just a few minutes of squeezing it.

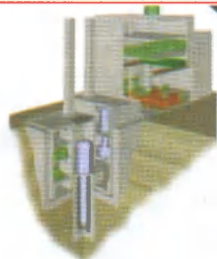


WHISTLE KEYFINDER

Most of us would have experienced the sinking feeling of having lost our set of keys one time or another. Whistle keyfinder works slightly differently compared to all the other keyfinders in the market, as all you need to do is give a nice whistle and the Keyfinder, should it detect your whistle, will light up and beep noisily until you successfully locate the merry bunch of keys. Of course, it would help if the batteries in the whistle keyfinder have enough juice to work, so make sure you test the batteries from time to time and replace when necessary.



MICRO NUCLEAR REACTOR



Toshiba has developed a micro nuclear reactor measuring only 20 feet by 6 feet and designed to power individual apartment buildings or city blocks. Unlike traditional reactors, this new design does not use control rods to initiate the reaction. It uses reservoirs of liquid lithium-6, an isotope that is effective at absorbing neutrons. Connected to a vertical tube, the Lithium-6 reservoir fits into the reactor core. At 200-kilowatt capacity, the reactor is self-sustaining, engineered to be fail-safe and can last for up to 40 years.

FRESHLY MADE PIZZA OR USB DRIVE

Feeling hungry? Try staring at these USB Drives? You just may turn off the computer and head to the fast food joint in a hurry. They are adorable and functional too. They come in the form of a hamburger, hotdog, bread, pizza slice, and sub sandwich. Some of the specifications are: USB specifications 1.0, 1.1, 1.2, 2.0 compliance support, plug and play, transferring rate up to 8 Mbit per second at high speed, at least 10 years of data retention with 1,000,000 times storage, support Mac, Windows ME, 2000 and XP, and 2GB internal memory.

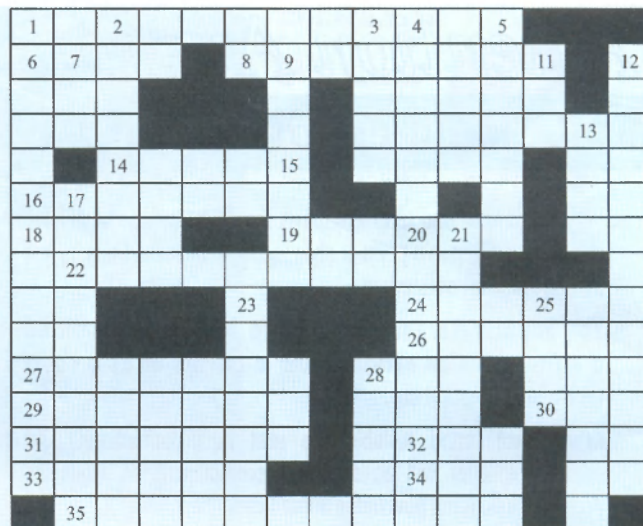


ACROSS

1. Morphological differences within the same species (12)
6. Presence of this is one of the characteristics of mammals (4)
8. Coverings of the brain (8)
14. First chamber of ruminant stomach (5)
16. Covering of the testicles in mammals (7)
18. Nutritive substance found in eggs (4)
19. One of the two bones of the fore arm (6)
22. Suicidal bag of the cell (8)
24. Locomotor organelle of Paramecium (5)
26. Immunologically competent cell (3)
27. Another name for environmental biology (7)
28. Bovine Serum Albumin (3)
29. Junction between axon and dewdrop (7)
30. The bundle of fibres present in the inter-ventricular septum is named after him (3)
31. Another name for Hexapoda (7)
32. Radio Immuno Assay (3)
33. Vocal organ of birds (6)
34. Another name for the hormone Vasopressin (3)
35. Sleeping sickness is caused by this parasite (11)

DOWN

1. Plants prepare their food by this process (14)
2. Largest gland in our body (5)
3. Neck region of the antibody molecule (5)
4. The region of DNA which has no corresponding on-RNA during transcription (6)
5. Reduction division in a cell (7)
7. Energy currency (3)
9. Brain function is detected by this instrument (3)
10. Hereditary character is determined by this molecule (4)



11. Scanning Electron Microscope (3)
12. Gradual development of an individual (13)
13. Generic name of honey-bee (4)
15. Nuclear Magnetic Resonance (3)
17. Another name for large intestine (5)
20. Cutting tooth (7)
21. Accumulation of this acid in knee-joint results in gout (8)
23. Vaccine for tuberculosis (3)
25. Interstitial cell stimulating hormone (4)
28. Jaws without teeth form this structure in birds (4)

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Answer to July 2010 crossword

